

SET NO. _____

**PROJECT MANUAL FOR CHILLER REPLACEMENT
AT
DEER'S HEAD HOSPITAL**

351 DEERS HEAD HOSPITAL ROAD
SALISBURY, WICOMICO COUNTY, MARYLAND 21802

FOR THE
MARYLAND DEPARTMENT OF GENERAL SERVICES

DGS PROJECT NO. H-453-210-001

PROJECT COST CLASSIFICATION = "D"

OCTOBER 13, 2023

STATE OF MARYLAND

DEPARTMENT OF GENERAL SERVICES

Atif Chaudhry, Jr., Secretary
301 West Preston Street
Baltimore, Maryland 21201

BOARD OF PUBLIC WORKS

Wes Moore, Governor
Brooke E. Lierman, Comptroller
Dereck E. Davis, Treasurer

MINORITY BUSINESS ENTERPRISES ARE ENCOURAGED TO RESPOND TO THIS SOLICITATION

HENRY ADAMS, LLC – Consulting Engineers

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HENRY ADAMS, LLC
October 13, 2023
DGS Project Number: H-453-210-001
Bid Set

Chiller Replacement
at Deer's Head Hospital
351 Deers Head Hospital Rd
Salisbury (Wicomico County), MD

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- 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).**

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Contractors Qualifications.
4. Contractor's use of site and premises.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.

1.2 PROJECT INFORMATION

A. Project Identification: Replace Chillers at the Deer's Head Hospital Center

1. Project Location:
351 Deer's Head Hospital Road
Salisbury, MD 21802

B. Owner: Maryland Department of General Services
Janice Howell
Maryland Department of General Services
301 W. Preston Street
Baltimore, MD 21201

C. Architect: Henry Adams, LLC.
600 Baltimore Avenue
Baltimore, MD 21202

1. Architect's Representative: Peter J. Puszcz, PE

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Removal of existing chilled water pumps, associated piping, and boilers.
2. Provide new water-cooled chillers, chilled water pumps, and associated piping.
3. Provide new refrigeration monitoring system with associated exhaust.
4. Provide for a new chilled water tie-in to an existing chilled water system
5. Provide for the addition of shut-off valves at existing AHU 3-way control valves, along with any required associated controls upgrades.
6. Provide new DDC chiller control system.

B. Type of Contract:

1. This is covered by Division 00 per requirements of the Maryland Department of General Services.

C. Base Bid:

1. The cost to complete all work as described in the project documents excluding any extended unit prices and alternates. The base bid shall include without limitation, labor, materials, bailing, shoring, removal, overhead, profit, insurance to include builder risk if applicable.
 - a. Note: refer to the instructions to bidders for construction projects, number 3 components of the bid.

1.4 QUALIFICATIONS OF THE CONTRACTOR:

- A. The Contractor shall possess all license(s) required by the State of Maryland and the subdivision in which the project work is performed (if applicable). The required license(s) shall be current. All employees utilized by the Contractor to perform work on this project shall each be licensed as necessary or covered under the Contractor's licensing appropriately. A copy of the Contractor's license is to be provided to the DGS Procurement Officer and/or Project Manager if required.
- B. Experience of Contractor: The bidder shall, prior to submitting a bid for the work covered by this specification, have no less than five (5) years' experience in providing the services of the type(s) required by the specifications. The experience must have been within the past five (5) years. Additionally, where required by the respective Manufacture(s), the Contractor shall be authorized by the Manufacture(s) to supply, install, and provide service to those items by the Contractor.
- C. The Contractor shall also be authorized by the respective Manufacture(s) to provide the Owner with all Warranties as noted.
- D. Upon request, the contractor shall supply the Procurement Officer a list of similar Projects, which have been successfully completed by the contractor.
- E. The Contractor must provide the name and telephone number of the contact person who will be responsible for responding to work performed under this contract.

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- 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, parking garage, loading areas, and entrances serving premises clear and available to Government, Government's

employees, and emergency vehicles 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 Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

- A. Full Government Occupancy: Government will occupy Project site and existing building during entire construction period. Cooperate with Government during construction operations to minimize conflicts and facilitate Government usage. Perform the Work so as not to interfere with Government '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 Government and approval of authorities having jurisdiction.
 2. Notify Government not less than 72 hours in advance of activities that will affect Government s operations.

1.7 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
- B. On-Site Work Hours: Limit work to between 8 a.m. to 4:30 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Government and authorities having jurisdiction.
1. Weekend Hours: Not permitted.
 2. Hours for Utility Shutdowns: 72-hour notice.
 3. Hours for Core Drilling: 24-hour notice.
- C. On-Site Work Day Restrictions: Do not perform work resulting in utility shutdowns or resulting in noisy activity on-site during work black-out days.
- D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
1. Notify Government not less than three days in advance of proposed utility interruptions.
 2. Obtain Government 's written permission before proceeding with utility interruptions.
- E. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Government occupancy with Government.

1. Notify Government not less than one day in advance of proposed disruptive operations.
 2. Obtain Government 's written permission before proceeding with disruptive operations.
- F. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances within the existing building and on Government's property is not permitted.
- G. Employee Identification: Provide identification tags for issued by the Facility Security for Contractor personnel working on the Project site. Require personnel to use identification tags at all times.
- H. Employee Screening: Comply with Government 's requirements for drug and background screening of Contractor personnel working on Project site.
1. Maintain list of approved screened personnel with Government.

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. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

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. Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. 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 or Government that are not required to meet other Project requirements but may offer advantage to Contractor or Government.

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 provided in Project Manual.
 - 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 Government 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 Government.
 - 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.
 - 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 seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 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 15 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: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time 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 Government a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Government must assume. Government's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Government, 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.

HENRY ADAMS, LLC
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DGS Project Number: H-453-210-001
Bid Set

Chiller Replacement
at Deer's Head Hospital
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Salisbury (Wicomico County), MD

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

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. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. 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.

1.3 PROPOSAL REQUESTS

- A. Government-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 20 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.
- 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 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.

1.4 CHANGE ORDER PROCEDURES

- A. On Government's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Government and Contractor on AIA Document G701.

1.5 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 on a time and material basis of work required by the Construction Change Directive.
 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 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 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.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 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 through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- 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. Owner's 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. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 4. 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.
 5. 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.
 6. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
 7. 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.
 8. 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.
 9. 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.
 10. 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.
- 1.5 APPLICATIONS FOR PAYMENT
- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and Construction Manager and paid for by Owner.

- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager 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.
- E. 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.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. 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. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
- H. 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.
- I. 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. Evidence that claims have been settled.
 8. 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.
 9. Final liquidated damages settlement statement.
 10. Proof that taxes, fees, and similar obligations are paid.
 11. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Project meetings.
- B. Related Requirements:
 - 1. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 2. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

- A. RFI: Request for Information. Request from Government, 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, and in prominent location in **each** 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. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. 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 Government 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. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to 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, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable 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. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - c. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - d. Indicate required installation sequences.

- e. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans: Show fire-protection and fire-alarm 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.
- C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 2. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 3. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 4. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
- 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. Project number.
 3. Date.
 4. Name of Contractor.
 5. RFI number, numbered sequentially.
 6. RFI subject.
 7. Specification Section number and title and related paragraphs, as appropriate.
 8. Drawing number and detail references, as appropriate.
 9. Field dimensions and conditions, as appropriate.
 10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 11. Contractor's signature.

12. 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: **AIA Document G716**.
 1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. 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 **[or Construction Manager]** 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 012600 "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 **10** 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 software. Include not less than 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.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

- 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 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 Government and Architect of scheduled meeting dates and times a minimum of **ten** working 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 Government and Architect, within **three** days of the meeting.
- B. Preconstruction Conference: Government **will schedule and conduct** a preconstruction conference before starting construction, at a time convenient to Government and Architect, but no later than 10 days after execution of the Agreement.
1. Attendees: Authorized representatives of Government, 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. Critical work sequencing and long lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Preparation of Record Documents.
 - m. Use of the premises **and existing building**.
 - n. Work restrictions.
 - o. Working hours.
 - p. Government's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for disruptions and shutdowns.
 - s. Construction waste management and recycling.
 - t. Parking availability.
 - u. Office, work, and storage areas.
 - v. Equipment deliveries and priorities.
 - w. First aid.
 - x. Security.

- y. Progress cleaning.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. 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 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. Possible conflicts.
 - i. Compatibility requirements.
 - j. Time schedules.
 - k. Manufacturer's written instructions.
 - l. Warranty requirements.
 - m. Compatibility of materials.
 - n. Temporary facilities and controls.
 - o. Space and access limitations.
 - p. Regulations of authorities having jurisdiction.
 - q. Testing and inspecting requirements.
 - r. Installation procedures.
 - s. Coordination with other work.
 - t. Required performance results.
 - u. Protection of adjacent work.
 - v. 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.
- D. Project Closeout Conference: **Schedule and conduct**a project closeout conference, at a time convenient to Government 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 Government, 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. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: **Conduct** progress meetings at **biweekly** intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Government 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.
 3. 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) Status of submittals.
 - 4) Deliveries.
 - 5) Access.

- 6) Site use.
 - 7) Temporary facilities and controls.
 - 8) Progress cleaning.
 - 9) Quality and work standards.
 - 10) Status of correction of deficient items.
 - 11) Field observations.
 - 12) Status of RFIs.
 - 13) Status of Proposal Requests.
 - 14) Pending changes.
 - 15) Status of Change Orders.
 - 16) Pending claims and disputes.
 - 17) Documentation of information for payment requests.
4. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

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. Related Requirements:
1. Section 01 290 0 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
 2. Section 01 40 00 "Quality Requirements" for schedule of tests and inspections.

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. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- C. Event: The starting or ending point of an activity.
- D. 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.

- E. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 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. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Material Location Reports: Submit at weekly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Unusual Event Reports: Submit at time of unusual event.

1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.5 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.

- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of.
1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. 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 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following 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.
 - a. CHILLERS.
 3. 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.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. 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. Phasing: Arrange list of activities on schedule by phase.
 2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Limitations of continued occupancies.
 - b. Uninterruptible services.
 - c. Use-of-premises restrictions.
 - d. Environmental control.
- E. 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.

- F. 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.
- G. 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.
- H. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, 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.

1.6 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
 - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.7 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. Equipment at Project site.
 - 2. Material deliveries.

3. High and low temperatures and general weather conditions, including presence of rain or snow.
4. Testing and inspection.
5. Accidents.
6. Meetings and significant decisions.
7. Unusual events.
8. Stoppages, delays, shortages, and losses.
9. Meter readings and similar recordings.
10. Emergency procedures.
11. Orders and requests of authorities having jurisdiction.
12. Change Orders received and implemented.
13. Construction Work Change Directives received and implemented.
14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial completions and occupancies.
17. Substantial Completions authorized.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 00

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.

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.
- 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. PDF (Electronic) Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals for Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

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

1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 2. Web-Based Project 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.
- 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. Initial Review: Allow **15]** 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.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow **15** days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Government, or other parties is indicated, allow **21** days for initial review of each submittal.
 - a. Submittal items requiring sequential review will be identified by Architect when submittal schedule is submitted for review.
- 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. Statement of compliance with specified referenced standards.
 - d. Testing by recognized testing agency.
 - e. Application of testing agency labels and seals.
 - f. Notation of coordination requirements.
 - g. Availability and delivery 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.
- 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.

- C. 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 Government, and other information specified.
- D. 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.
- E. 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.
- F. 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 and three** paper 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.

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 **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 it.
 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.

2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
 - 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 **return without review** 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 01 33 00

SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. 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.
- D. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- E. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- F. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- G. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- H. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- I. Retain: To keep existing items that are not to be removed or dismantled.
- J. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
 - 1. Schedule construction operations in sequence required to obtain best Work results.
 - 2. Coordinate sequence of alteration work activities to accommodate the following:

- a. Government's continuing occupancy of portions of existing building.
 - b. Government's partial occupancy of completed Work.
 - c. Other known work in progress.
 - d. Tests and inspections.
3. Detail sequence of alteration work, with start and end dates.
 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
 5. Use of elevator and stairs.

1.4 PROJECT MEETINGS FOR ALTERATION WORK

A. Preliminary Conference for Alteration Work: Before starting alteration work, **conduct** conference at **Project site**.

1. Attendees: In addition to representatives of Government, Architect, and Contractor, testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
 - a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Fire-prevention plan.
 - c. Governing regulations.
 - d. Areas where existing construction is to remain and the required protection.
 - e. Hauling routes.
 - f. Sequence of alteration work operations.
 - g. Storage, protection, and accounting for salvaged and specially fabricated items.
 - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - i. Qualifications of personnel assigned to alteration work and assigned duties.
 - j. Requirements for extent and quality of work, tolerances, and required clearances.
 - k. Collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
3. Reporting: **Record** conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at bi-weekly intervals. 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 Government, Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.

2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
 - a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
 - b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:
 - 1) Interface requirements of alteration work with other Project Work.
 - 2) Status of submittals for alteration work.
 - 3) Access to alteration work locations.
 - 4) Effectiveness of fire-prevention plan.
 - 5) Quality and work standards of alteration work.
 - 6) Change Orders for alteration work.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.5 INFORMATIONAL SUBMITTALS

- A. Alteration Work Subschedule:
 1. Submit alteration work subschedule within **seven** days of date established for **commencement of alteration work**.
- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- C. Alteration Work Program: Submit **30 days** before work begins.
- D. Fire-Prevention Plan: Submit **30 days** before work begins.

1.6 QUALITY ASSURANCE

- A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of **five** recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.

1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Government's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
 3. Store items in a secure area until delivery to Government.
 4. Transport items to Government's storage area as directed **by** Government.
 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
 1. Repair and clean items for reuse as indicated.
 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label 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 unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
 2. Secure stored materials to protect from theft.
 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F or more above the dew point.
- E. Storage Space:
1. Government will arrange for limited on-site location(s) for free storage of salvaged material. This storage space **includes** security for stored material.
 2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.

1.8 FIELD CONDITIONS

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of **measured drawings**.
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by **12 inches** or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, surrounding surfaces of building and building from harm resulting from alteration work.
1. Use only proven protection methods, appropriate to each area and surface being protected.
 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 3. Erect temporary barriers to form and maintain fire-egress routes.
 4. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
 5. Protect floors and other surfaces along hauling routes from damage, wear, and staining.

- B. Temporary Protection of Materials to Remain:
 - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
 - 1. Notify Government, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 - 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
 - 1. Comply with NFPA 241 requirements unless otherwise indicated.
 - 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
 - 1. Obtain Government's approval for operations involving use of welding or other high-heat equipment. **Use of open-flame equipment is not permitted.** Notify Government **at least 72 hours** before each occurrence, indicating location of such work.
 - 2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
 - 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
 - 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 - 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.

6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than **30 minutes** after conclusion of work **in each area** to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire-watch personnel at **each area of** Project site until **60 minutes** after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
 1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- D. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 01 35 16

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, Government, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

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]** <Insert number> 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. 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.
- E. 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.

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

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.
- 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 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. 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.
- D. 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.
- E. Reports: Prepare and submit certified written reports and documents as specified.
- F. Permits, Licenses, and Certificates: For Government'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.

1.6 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.

1.7 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.

1.8 QUALITY CONTROL

- A. Government Responsibilities: Where quality-control services are indicated as Government's responsibility, Government will engage a qualified testing agency to perform these services.
 - 1. Government 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.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Government 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 Government, unless agreed to in writing by Government.
 - 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, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect 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 013300 "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. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. 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.

1.9 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Government will engage a qualified **special inspector** to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Government, 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 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 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 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 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- C. "Provide": Furnish and install, complete and ready for the intended use.

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.
- 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.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: 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. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 2. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 3. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 4. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
 - 5. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 6. AGA - American Gas Association; www.aga.org.
 - 7. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 8. AIA - American Institute of Architects (The); www.aia.org.
 - 9. AISC - American Institute of Steel Construction; www.aisc.org.
 - 10. AISI - American Iron and Steel Institute; www.steel.org.

11. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
12. ANSI - American National Standards Institute; www.ansi.org.
13. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
14. ARI - American Refrigeration Institute; (See AHRI).
15. ASCE - American Society of Civil Engineers; www.asce.org.
16. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
17. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
18. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
19. ASSP - American Society of Safety Professionals (The); www.assp.org.
20. ASTM - ASTM International; www.astm.org.
21. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
22. AVIXA - Audiovisual and Integrated Experience Association; (Formerly: Infocomm International); www.soundandcommunications.com.
23. AWI - Architectural Woodwork Institute; www.awinet.org.
24. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
25. AWPA - American Wood Protection Association; www.awpa.com.
26. AWS - American Welding Society; www.aws.org.
27. AWWA - American Water Works Association; www.awwa.org.
28. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
29. BICSI - BICSI, Inc.; www.bicsi.org.
30. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
31. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
32. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
33. CGA - Compressed Gas Association; www.cganet.com.
34. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
35. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
36. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
37. CRRC - Cool Roof Rating Council; www.coolroofs.org.
38. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
39. CSA - CSA Group; www.csa-group.org.
40. CSI - Construction Specifications Institute (The); www.csiresources.org.
41. CTA - Consumer Technology Association; www.cta.tech.
42. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.coolingtechnology.org.
43. CWC - Composite Wood Council; (See CPA).
44. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
45. DHA - Decorative Hardwoods Association; (Formerly: Hardwood Plywood & Veneer Association); www.decorativehardwoods.org.
46. DHI - Door and Hardware Institute; www.dhi.org.
47. ECA - Electronic Components Association; (See ECIA).
48. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
49. ECIA - Electronic Components Industry Association; www.eciaonline.org.
50. EIA - Electronic Industries Alliance; (See TIA).
51. EIMA - EIFS Industry Members Association; www.eima.com.
52. ESTA - Entertainment Services and Technology Association; (See PLASA).
53. ETL - Intertek (See Intertek); www.intertek.com.
54. FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.

55. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
56. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
57. FM Approvals - FM Approvals LLC; www.fmglobal.com.
58. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
59. GA - Gypsum Association; www.gypsum.org.
60. HPVA - Hardwood Plywood & Veneer Association; (See DHA).
61. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
62. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
63. IAS - International Accreditation Service; www.iasonline.org.
64. ICBO - International Conference of Building Officials; (See ICC).
65. ICC - International Code Council; www.iccsafe.org.
66. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
67. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
68. IEC - International Electrotechnical Commission; www.iec.ch.
69. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
70. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
71. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
72. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
73. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
74. ISO - International Organization for Standardization; www.iso.org.
75. LPI - Lightning Protection Institute; www.lightning.org.
76. MBMA - Metal Building Manufacturers Association; www.mbma.com.
77. MCA - Metal Construction Association; www.metalconstruction.org.
78. MPI - Master Painters Institute; www.paintinfo.com.
79. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
80. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
81. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
82. NADCA - National Air Duct Cleaners Association; www.nadca.com.
83. NECA - National Electrical Contractors Association; www.necanet.org.
84. NEMA - National Electrical Manufacturers Association; www.nema.org.
85. NETA - InterNational Electrical Testing Association; www.netaworld.org.
86. NFPA - National Fire Protection Association; www.nfpa.org.
87. NFPA - NFPA International; (See NFPA).
88. NSF - NSF International; www.nsf.org.
89. NSPE - National Society of Professional Engineers; www.nspe.org.
90. SDI - Steel Door Institute; www.steeldoor.org.
91. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
92. SIA - Security Industry Association; www.siaonline.org.
93. SJI - Steel Joist Institute; www.steeljoist.org.
94. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
95. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.

96. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
 97. UL - Underwriters Laboratories Inc.; www.ul.com.
 98. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
 99. WA - Wallcoverings Association; www.wallcoverings.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. COE - Army Corps of Engineers; www.usace.army.mil.
 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 4. DOD - Department of Defense; www.quicksearch.dla.mil.
 5. DOE - Department of Energy; www.energy.gov.
 6. EPA - Environmental Protection Agency; www.epa.gov.
 7. FAA - Federal Aviation Administration; www.faa.gov.
 8. FG - Federal Government Publications; www.gpo.gov/fdsys.
 9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. 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 Government Printing Office; www.govinfo.gov.
 2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 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.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
 6. MILSPEC - Military Specification 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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS; California Department of Health Services; (See CDPH).
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
 7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. 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 01 25 00 "Substitution Procedures" for requests for substitutions.
 - 2. Section 01 42 00 "References" for applicable industry standards for products specified.
 - 3. Section 01 77 00 "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, 26, and 28 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 Government or endorsed by manufacturer to Government.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Government and issued in the name of the Government or endorsed by manufacturer to Government.
- 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. Government reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 5. 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** 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** 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. 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.

- a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- 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.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- 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.

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 Government, if requested.
 5. Samples, if requested.
- B. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- C. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

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. Installation of the Work.
 4. Cutting and patching.
 5. Coordination of Government's portion of the Work.
 6. Coordination of Government-installed products.
 7. Progress cleaning.
 8. Starting and adjusting.
 9. Protection of installed construction.

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 **submitting cutting and patching plan**, 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 fire protection 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.

1.4 INFORMATIONAL SUBMITTALS

- A. 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.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

- A. 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. **Operational elements include the following:**
 - a. Primary operational systems and equipment.
 - b. Fire-suppression systems.
 - c. Plumbing piping systems.
 - d. Mechanical systems piping and ducts.
 - e. Control systems.
 - f. Communication systems.
 - g. Fire-detection and -alarm systems.
 - h. Conveying systems.
 - i. Electrical wiring systems.
 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.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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.
- B. 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.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. 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.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. 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."

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.

3.4 FIELD ENGINEERING

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. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. 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.
- H. 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.
- I. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 01 77 00 "Closeout Procedures" for repairing or removing and replacing defective Work.

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 01 10 00 "Summary."
- F. Existing Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to **prevent** interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. **Concrete and Masonry**: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Proceed with patching after construction operations requiring cutting are complete.
- 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.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - c. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 3. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
- 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 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 74 19 "Construction Waste Management and Disposal."**
- 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.

3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.9 PROTECTION AND REPAIR 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. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. 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.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 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.

1.3 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 demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Government's property.
- 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.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within **7** days of date established for **the Notice to Proceed**.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
1. Material category.
 2. Generation point of waste.
 3. Total quantity of waste in tons (tonnes).
 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
 5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 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**.

1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent **may** serve as Waste Management Coordinator.
- B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

- C. 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.

1.8 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. **Distinguish between demolition and construction waste.** 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 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 Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 3. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 4. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 5. 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 **75** 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.

1. Demolition Waste:

- a. Rough hardware.
- b. Roofing.
- c. Acoustical tile and panels.
- d. Carpet.
- e. Carpet pad.
- f. Equipment.
- g. Cabinets.
- h. Piping.
- i. Supports and hangers.
- j. Valves.
- k. Sprinklers.
- l. Mechanical equipment.
- m. Electrical conduit.
- n. Copper wiring.
- o. Smoke detectors.
- p. Pull stations.
- q. Bells.
- r. Strobes.

2. Construction Waste:

- a. Gypsum board.
- b. Piping.
- c. Electrical conduit.
- d. 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.
- e. 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 015000 "Temporary Facilities and Controls."
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 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.
- C. 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 02 41 19 "Selective Demolition"** for salvaging demolition waste.
- B. Salvaged Items for **Sale and Donation: Not permitted** on Project site.
- C. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- D. Electrical Devices: Separate devices by type.

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 Government's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Metals: Separate metals by type.
 - 1. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- B. 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.
- C. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- D. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- E. Conduit: Reduce conduit to straight lengths and store by material and size.

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. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Government's property.

C. 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.

END OF SECTION 01 74 19

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 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 01 79 00 "Demonstration and Training" for requirements to train the Government'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 **10** 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 Government 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 **Architect**. 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 Government's signature for receipt of submittals.
5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Government's occupancy, use, operation, and maintenance.

- C. Procedures Prior to Substantial Completion: Complete the following a minimum of **10** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Government of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Government. Advise Government'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 Government's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Government of changeover in utility services.

7. Participate with Government 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 **10** days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect 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 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect 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 (PUNCH LIST)

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, **proceeding 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 following format:
 - a. MS Excel Electronic File: Architect will return annotated file.
 - b. PDF Electronic File: Architect will return annotated file.

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 Government's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. 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 **by email to Architect**.
- D. 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.

- E. 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.

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. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - c. Remove snow and ice to provide safe access to building.
 - d. Clean exposed interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances.
 - e. Remove labels that are not permanent.
- C. Construction Waste Disposal: Comply with waste-disposal requirements in **Section 01 74 19 "Construction Waste Management and Disposal."**

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 01 77 00

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.

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. Prior to requesting inspection for substantial completion, submit the operation and maintenance manuals to the DGS resident inspector for review for completeness.
 2. If the manuals are acceptable to DGS, submit the operation and maintenance manuals to the Architect as a submittal. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 3. 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. PDF electronic file. Assemble each file into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 2. Submit by **email to Architect**.

- C. Initial Manual Submittal: Submit draft copy of each manual at least **30** days before commencing demonstration and training. Architect 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 **15** days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within **15** 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, **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, **and** 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 Government.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. 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 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Government'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. Water leak.
 - 3. Power failure.
 - 4. Water outage.
 - 5. System, subsystem, or equipment failure.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Government'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.

1.7 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 Government'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.

1.8 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 Government'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.

1.9 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. Government Required Items:

1. Start-up Report.
2. Equipment and Systems Performance Test Report.
3. Commissioning Report.
4. Video CD of Demonstration and Training.

G. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

H. 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 01 78 23

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. Miscellaneous record submittals.
- B. Related Requirements:
1. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 2. 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 **one** set of marked-up record prints.
 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit **one** paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and **one** set of file prints.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit **two** paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned Record Prints and **three** set(s) of file prints.
 - 3) Print 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. 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** of each submittal.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark 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. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive 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 marked-up 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 marked on 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. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file **with comment function enabled**.
 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. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect .
 - e. Name of Contractor.

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. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 5. 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 MISCELLANEOUS RECORD 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.
- B. Format: Submit miscellaneous record submittals as **PDF electronic file**.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 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 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Government's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

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 video recording of live instructional module.
- B. Qualification Data: For facilitator, instructor and videographer.
- 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: 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 Government's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 01 78 23 "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 Government's operations. Adjust schedule as required to minimize disrupting Government's operations and to ensure availability of Government'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 Government for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Government's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Government will furnish Contractor with names and positions of participants.

- 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 Government, through Architect, with at least seven 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. Cleanup: Collect used and leftover educational materials and give to Government. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 79 00

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Commissioning requirements common to all Sections.
- B. Pre-Functional Checklists, systems and equipment startup documentation.
- C. Functional Performance Testing.
- D. Documentation of tests, procedures, and installations.
- E. Coordination and requirements of training events.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Division 23 – Heating Ventilating and Air Conditioning
- C. Division 26 – Electrical
- D. Commissioning Plan: The Commissioning Plan encompasses the entire Commissioning process including pre-construction, construction and post construction phases and tasks.

1.3 QUALITY ASSURANCE

- A. Commissioning (Cx) is the process of ensuring that all building systems are installed and perform interactively according to the design intent and meet the Government's operational needs; that the installation is adequately documented; and that the Building Operations staff are adequately trained to operate the facility. Commissioning helps minimize post-acceptance operational problems and establishes testing and communication protocols that advance the building systems from design to installation to full operation.
- B. The specifications dictate all requirements of the commissioning process relative to the construction contract. The Commissioning Plan outlines the commissioning process. The Contractor shall be responsible for complying with any additional duties or responsibilities contained in the he Commissioning Plan that are not otherwise specified in the Contract Documents.

1.4 SCOPE

- A. This Section covers commissioning procedures and protocols common across Divisions 23 and 26.

- B. Requirements specific to individual Sections are specified in the technical specifications.
- C. The systems to be commissioned consist of the following:
 - 1. Mechanical/HVAC Systems
 - a. New Water-Cooled Chillers
 - b. New Chilled Water Pumps
 - c. New Exhaust Fans
 - d. New BAS and Automated Controls
 - e. New Heat Trace
 - 2. Electrical Systems
 - a. New Variable Frequency Motor Controllers
- D. The Contractor shall execute a Commissioning Program, which delivers the intended results of an HVAC System Commissioning, using whatever personnel, time and resources are required.

1.5 DEFINITIONS AND ABBREVIATIONS

- A. Acceptance Phase: This is the phase of the project when the facility and its systems and equipment are inspected, tested, verified, and documented; and when most of the Functional Performance Testing and formal training occurs.
- B. Action Item: Any issue that requires a response, completion, corrective or additional work, or any other action. A list will be maintained and updated by the CxA that includes all Action Items that relate to Commissioning activities.
- C. Building Automation System (BAS): The computer-based control or automation system.
- D. Commissioning (Cx): The process of ensuring that all building systems perform interactively according to the design intent and meet the Government's operational needs
- E. Commissioning Agent (CxA): The firm who will manage the commissioning process, develop and stipulate many of the commissioning requirements, and who ensures and validates that systems and equipment are designed, installed and tested to meet the Government's requirements.
- F. Commissioning Team (CxT): The commissioning process participants, including the Government
- G. Deficiency: An installation or condition that is not in conformance with the construction documents.
- H. Functional Performance Testing (FPT): The detailed and thorough testing of the building systems and their interactions with building components and other building systems.
- I. Pre-Functional Checklist (PFC): A checklist used to as a guide to confirm and document proper equipment installation and checkout.

- J. Startup: Refers to the quality control process whereby the Contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the manufacturer's startup checklist, energizes the device, completes the startup tests, and verifies that it is in proper working order and ready for dynamic testing.
- K. Commissioning Issues/Benefits Log (Issues Log): A list of items tracked by the CxA that require action by various members of the commissioning team. The log tracks items that require action and resolution such as a design related clarification, field observation or testing deficiency.

1.6 REFERENCE STANDARDS AND DOCUMENTS including but not limited to:

- A. ASHRAE Guideline 0-2019, The Commissioning Process
- B. ASHRAE/IES Standard 202-2018, Commissioning Process for Buildings and Systems
- C. ACG Commissioning Guideline (Current Edition)
- D. NEBB – Procedural Standards for Building Systems Commissioning (Current Edition)

1.7 DOCUMENTATION

- A. Contractor shall submit qualifications for Cx Coordinator, who may also hold additional responsibilities on the Contractor's team.
- B. Submittals: Provide an electronic copy of all approved equipment and system submittals.
- C. Factory Test Reports: Prior to Functional Performance Testing the Contractor shall provide any factory testing documentation or certified test reports required by the specifications.
- D. Schedule Updates: Provide the CxA with schedule updates when issued to the construction team.
- E. Action Item and/or Systems Issues Log Response: Respond to Systems Issues Log and Action Items to which CxA team members assign the Contractor responsibility.
- F. Pre-Functional Checklists: Complete pre functional checks of equipment and systems and provide signed and completed documents to the CxA.
- G. Factory and Manufacturer's Test Reports: Prior to Functional Performance Testing the Contractor shall provide any factory or manufacturer's testing documentation or certified test reports required by the specifications.
- H. Functional Performance Tests: Provide completed and signed FPT documentation.
- I. Training Documentation: Provide record of all training documentation. Refer to Specification Section 01 79 00 Demonstration and Training for deliverables.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

- A. The Contractor provides all tools, equipment, and instruments needed for the testing process. All testing equipment used by the Contractor in the commissioning process shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified. All equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags shall be affixed to equipment or certificates readily available.
- B. The Contractor shall provide any special equipment, tools and instruments (only available from a vendor, and specific to a piece of equipment) that are required for testing equipment. These shall be provided to the Owner as part of the contract. (for example, a handheld device that is necessary to retrieve, change, and view information from a manufacturer's proprietary controller).

PART 3 - EXECUTION

3.1 RESPONSIBILITIES

- A. Contractor responsibilities include but are not limited to:
 - 1. Designate a Cx Coordinator who is authorized to direct subcontractors and make commissioning related schedule and scope of work decisions. Cx Coordinator may have other roles on the GC's project team.
 - 2. Designate a Cx Coordinator from each major subcontractor with activities related to commissioning. Engage the subcontractors to directly participate and support the commissioning process.
 - 3. Attend Cx Kick-Off Meeting.
 - 4. Attend all Cx progress meetings.
 - 5. Provide documentation listed in Section 1.7 Documentation to the CxA.
 - 6. Schedule and coordinate Cx efforts into the construction schedule.
 - 7. Submit commissioning agent RFIs through the normal RFI flow of the project. Incorporate responses into the construction process, including as-builts.
 - 8. Respond to and address CxA comments on the submittals and O&Ms, including providing revised submissions when requested to clarify or correct information.
 - 9. Perform equipment and system start-up and provide documentation to the CxA.
 - 10. Review draft PFCs and FPTs provided by the CxA, and provide comments to the CxA.
 - 11. Complete PFCs and provide documentation to the CxA.
 - 12. Conduct and document the FPT procedures as directed and witnessed by the CxA.
 - 13. Provide the necessary tools, technicians, utilities, access, lifts, ladders, etc. to support the testing.
 - 14. Remedy any deficiencies identified through commissioning
 - 15. Demonstrate the operation of all systems via the FPT process.
 - 16. Respond to and proactively resolve Issues Log items tracked by the CxA.
 - 17. Conduct and document equipment and systems training events in accordance with the specifications.
 - 18. Participate in opposite season and deferred testing as needed.
 - 19. Give minimum two (2)-week notice to the COR and CxA for any commissioning activity which must be witnessed by the CxA. Provide at least (1) week notice for commissioning

related testing that the CxA may witness, such as system pressure testing, TAB activities, and manufacturer's startups.

B. Commissioning Agent responsibilities include but are not limited to:

1. Operate as a third-party advocate for the Government.
2. Manage and lead the commissioning process.
3. Create and update the Commissioning Plan.
4. Review the Government's Project Requirements (OPR) and the Basis of Design (BOD) documents.
5. Review the design documents.
6. Lead commissioning meetings and issue meeting minutes.
7. Review select product data submittals and O&M manuals.
8. Create PFCs and FPTs. Offer the checklists and procedures to the team for review and input, and update the documents when necessary.
9. Backcheck select PFCs to confirm thoroughness and accuracy.
10. Conduct and issue reports.
11. Direct and witness functional testing conducted by the contractors.
12. Track systems issues discovered during the Cx process.
13. Facilitate the O&M training process.
14. Generate the Commissioning Report.
15. Conduct seasonal testing, if required, and update Commissioning Report.

C. CM responsibilities include:

1. Review and provide input on the Cx Plan, PFCs, and FPTs.
2. Attend commissioning meetings and participate in the commissioning process.
3. Copy the CxA on construction progress and owners meeting minutes.
4. Provide requested information to the commissioning agent.
5. Resolve GC contractual matters related to the commissioning process.
6. Enforce commissioning, testing, and QA/QC requirements during contractor performance of the work.
7. Work with the GC, COR, and CxA to proactively resolve issues.
8. Inspect systems, equipment, and related components for construction acceptance (the commissioning process does not replace the construction QA/QC process).

D. Owner responsibilities include:

1. Contract an independent Commissioning Agent.
2. Determine and document the Government's Project Requirements.
3. Provide availability of O&M staff for training purposes and time for the Maintenance Supervisor to participate in the commissioning process as appropriate.
4. Determine final acceptance of the systems based on CxA recommendations.
5. Engage staff as needed to provide input to the AE and COR for the Government's Project Requirements and general project programming requirements.

E. Maintenance Supervisor (MS) responsibilities include:

1. Attend Cx meetings.
2. Participate in the commissioning process to the extent possible to better assist in the transition of the facility from Construction and Acceptance to O&M.
3. Provide input to the OPR / BOD.

4. Provide input to the COR, and CxA regarding the desired level of training and the documentation needs of the facility.
5. Provide access to base building systems and networks for systems related renovations.
6. Schedule techs to attend portions of FPTs to better understand the systems operations prior to turnover.
7. Actively participate and schedule crews for the O&M training process.

3.2 COMMISSIONING SEQUENCING AND SCHEDULING

- A. Commissioning is categorized in the phases indicated below. Note that different systems and/or areas may be in different commissioning phases at any given time.
 1. Pre-Construction Phase: All activities and coordination that take place prior to the start of construction. This includes preparation of the Commissioning Plan, review of the Government's Project Requirements, Basis of Design, drawings and specifications.
 2. Construction Phase: This period starts with the construction phase commissioning kick-off meeting and the product data submittal process. Preliminary O&Ms are produced. Checklists and functional test procedures are developed. The systems are installed. The Construction Phase ends as the systems transition into start-up and testing.
 3. Acceptance Phase: In this period systems are started, TAB is performed, and functional testing is conducted. Training is completed concurrently with the testing and final O&Ms are submitted. The systems will operate through any endurance period and trends shall be programmed on the BAS. This period ends with satisfactory completion of all functional performance tests prior to Substantial Completion or Post-Acceptance.
 4. Post-Acceptance Phase: The Post-Acceptance phase starts after all FPTs are complete and accepted by Government, and systems are operating per the Contract Documents. The Post-Acceptance Phase runs concurrent with the warranty period. During this period the CxA submits the Cx Report. The Contractor closes any remaining Issues Log items, addresses any warranty items, and completes any remaining deferred or seasonal testing. This phase ends one-year after Substantial Completion.
- B. Prior to submission of the baseline schedule, Contractor will coordinate with the CxA to specifically include the detailed tasks involved in the Cx Process. Contractor shall incorporate the commissioning tasks for EACH SYSTEM. Contractor shall submit each schedule update directly to the CxA and incorporate and respond to any CxA schedule comments.
- C. Contractor shall notify the CxA in writing at least 14 days in advance of any tests, start-ups, or training. CxA shall witness selected tests and start-ups, and at least 7 days in advance for activities that the CxA may witness at its option (such as pressure testing, flushing, start-up, and TAB).

3.3 PRE-FUNCTIONAL CHECKLISTS AND START-UP PROCEDURES

- A. The CxA will create the Pre-Functional Checklists (PFCs) based on manufacturers' startup procedures and checklists, which shall be provided by the Contractors. The CxA will utilize the product submittals, contract documents, and other relevant information as needed to ensure that the startup phase documentation is complete. The contractors will use the PFCs as a guide to check each piece of equipment and system installation and document the results.

- B. Prepare and submit Startup Procedures. Contractor shall provide manufacturer's installation and start-up documentation, including manufacturer's standard startup checklists, forms, and protocols. Provide information early in the construction process so the CxA and the construction team have the information for preparation of the Pre-Functional Checklists.
- C. Equipment and system start-up are contractor responsibilities. The CxA will selectively witness startups. Contractor will coordinate with the CxA to confirm startup schedule. Provide factory trained/authorized technicians where required by the contract documents and stated in the applicable technical section. Generally, startup and testing shall proceed from device checkout, to component checkout, to system checkout, to interrelated system checkout.
- D. Contractor shall provide completed PFCs, startup documentation, and the Test and Balance Report (TAB Report) for the equipment to be tested to CxA prior to any associated functional performance testing. Any outstanding item shall be clearly indicated and an associated action item must be tracked to resolution. By submitting the completed documentation, the contractor is confirming that it has successfully checked out, started-up, balanced, and confirmed proper operation of the systems to be tested.

3.4 FUNCTIONAL PERFORMANCE TESTING

- A. Functional Performance Testing demonstrates that each system is operating according to the Contract Documents. The tests will verify the full operation of every mode of operation, sequence, control point, input, output, device, meter, sensor, component, alarm, and graphic of every piece of equipment and system in every mode of operation. All portions of the sequence of operation will be tested and verified.
- B. The CxA will develop the FPTs. The Cx Team will review the draft FPTs and provide comments to the CxA. The CxA shall update the FPTs as needed.
- C. The contractors shall conduct the FPTs and provide the following:
 - 1. Manipulate systems and equipment to facilitate testing.
 - 2. Provide any specialized instrumentation necessary for Functional Performance Testing.
 - 3. Manipulate the BAS and other control systems to facilitate Functional Performance Testing.
 - 4. Correct any work found not in accordance with Contract Documents.
 - 5. Provide access to the equipment and systems for review and testing, such as removing and replacing ceilings, removing access panels, ladders, lifts, scaffolding, etc.
- D. The CxA determines the pass or failure of each step of the FPT process. Items that fail must be corrected and retested at no additional cost to the Government. Corrections of minor deficiencies may be made during the tests at the discretion of the CxA and will be documented.
- E. The CxA will record all deficiencies or non-conformance issues in the project Issues Log as follows.
 - 1. The CxA will notify the COR, CM, Contractor and all members of the Cx Team of issues added or closed by distributing the Issues Log to the team on a regular basis.
 - 2. Items assigned shall be corrected by the responsible party and notice sent to the CxA that the item has been corrected and re-checked.

3. The Contractor shall provide applicable documentation and demonstrate the correction to the CxA.
 4. If there is a dispute about a deficiency, regarding whether it is a deficiency, and/or who is responsible, and/or a contractual issue then the contractor shall notify the CM, COR, and CxA to determine the outcome.
- F. Deferred Testing. Testing that cannot be completed during the acceptance phase due to seasonal or phasing issues will be conducted at a (later) time to be determined. Any items considered as deferred must be approved by the Government. Contractor is responsible for conducting seasonal and deferred testing in the same manner as the FPTs.
- G. Sampling. The CxA may incorporate an FPT sampling strategy at their discretion. Regardless, the contractor shall remain responsible for completing the PFCs for every single piece of equipment. Further, should a sampling group result in any failures, additional tests, or additional samples, the contractor shall remain responsible for the costs of completing FPTs of 100% of the equipment and systems.

3.5 TRAINING

- A. The contractor conducts the training and the CxA shall verify that adequate training has been provided. Refer to Section 01 79 00 Demonstration and Training for further requirements.

END OF SECTION 01 91 13

SECTION 23 05 00 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Requirements of this Section are applicable to work in Division 23.
- B. Contract Documents
 - 1. Unless otherwise modified, drawings and general provisions of the Contract, including provisions of General Conditions, DGS Procedure Manual for Professional Services, and Division 01 govern work under Division 23.
 - 2. Contract drawings for mechanical work are diagrammatic, intended to convey scope and general arrangement.
 - 3. Refer questions involving document interpretation or discrepancies to Contracting Officer's Representative (COR) for review and direction.
 - 4. Correct faulty work due to resolving discrepancies without proper approval.
 - 5. Specifications establish quality of materials, equipment, workmanship and methods of construction.
 - 6. Follow drawings and specifications in laying out work. Consult other applicable contract drawings and specifications, become familiar with conditions affecting work.
- C. Scope
 - 1. The work in Division 23 includes furnishing and installing the mechanical work complete and ready for satisfactory service.
 - 2. Requirements specified govern work in all sections of Division 23.
 - 3. Some of the work described in this section is also applicable to the scope of Division 26.

1.2 RELATED DIVISIONS

- A. Division 01 - General Requirements
- B. Division 07 - Thermal and Moisture Protection
- C. Division 23 - Heating, Ventilating, and Air Conditioning
- D. Division 26 - Electrical

1.3 QUALITY ASSURANCE

- A. Regulations: Comply with regulations of NFPA, state, county, municipal building ordinances, DGS Standards, and other applicable codes and regulations.
- B. Provide UL label on electric powered equipment or certification that equipment has been tested by a testing agency approved by the local authority as equivalent in safety to UL labeled equipment.
- C. Material and Equipment Requirements

1. Use products of one manufacturer where two or more items of same kind of equipment are required.
2. Materials and equipment shall have a record of one-year successful field use.
3. For certain items of equipment, the specification and the project design are based upon the specified manufacturer's product. Other manufacturers' names are listed. Contractor may purchase, conditional upon meeting project requirements, equipment from the listed manufacturers.
4. Only the manufacturer's equipment upon which, the specification and the project design has been based, has been checked for this project. Check allocated space and structure for suitability of equipment of other listed manufacturers, including parts replacement and servicing.

D. Workmanship

1. Remove and replace, at no extra cost, work not in conformance with contract requirements.
2. Coordinate work and cooperate with other trades to facilitate execution of work.

E. Coordination with Other Trades

1. Contractor shall give full cooperation and coordination with other trades and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily with the least possible interference or delay.
2. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans and shop details for the proper installation of the work and for the purpose of coordination adjacent work.

F. Asbestos or asbestos-containing materials shall not be utilized or allowed on this project. The Contractor shall be rigorous in assuring that all materials, equipment, systems, and components do not contain asbestos. Any deviations from this exclusion shall be remedied at the Contractor's expense without regard to prior submittal approvals.

G. Access: The Contractor shall specifically consider all materials and equipment installations and shall coordinate with the work of all trades to insure easy and unobstructed accessibility of all systems for operations, maintenance, repairs, and replacement. Installation of all specified materials and equipment including but not limited to, equipment, supports, ductwork, pipe, electrical conduit and controls shall be in a manner which will allow complete unobstructed access to all panels, access doors, filter racks, control boxes, controls actuators, sensors, valves, tube bundles and all other items requiring access for operations or maintenance. All items such as controls, actuators and valves which require servicing or manual operations for system use shall be located such as to be accessible without standing on other equipment, whenever it is possible or practical. Any installation of new equipment or materials which causes problems related to access of new or existing equipment shall be disapproved by the COR and reaccomplished by the Contractor.

1.4 SUBMITTALS

A. Manufacturer's technical product data, installation instructions and description of accessories for each type to be used and system designation:

1. Certificate of completion of cleaning and disinfecting of water systems.
2. Concrete compressive strength test.

3. Motors and power factor correction capacitors (submit under section specifying related equipment).
4. Layout drawings for equipment supports.
5. Pipe penetration seals.
6. Identification.
7. Charts for shutoff valve locations.
8. Operating and maintenance manuals.
9. Statement of field instruction completion.

1.5 APPLICABLE PUBLICATIONS

The publications listed in this section form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

A. References

1. References to standards, codes, catalogs and recommendations are latest edition in effect on date of invitation to bid.
2. Refer to applicable contract drawings and specifications pertaining to other Divisions for conditions affecting work.

B. Definitions: The following are definitions of terms and expressions used in Division 23:

1. "Approve" - To permit use of material, equipment or methods conditional upon compliance with contract document requirements.
2. "Concealed" - Hidden from normal sight; includes work in crawl spaces, above ceilings, and in building shafts.
3. "Directed" - directed by COR.
4. "Ductwork" - includes ducts, fittings, housings, dampers, supports and accessories comprising a system.
5. "Equal, equivalent" - possessing the same performance qualities and characteristics and fulfilling the same utilitarian function.
6. "Exposed" - not concealed.
7. "Furnish" - Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar operations.
8. "Indicated" - indicated in Contract Documents.
9. "Install" - Operations at project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning and similar operations.
10. "Piping" - includes pipe, fittings, valves, supports and accessories comprising a system.
11. "Provide" - furnish and install, complete and ready for the intended use.
12. "Removable" - detachable from the structure or system without physical alteration of materials or equipment and without disturbance to other construction.
13. "Review" - limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

B. Refer to Division 01, "References" for additional definition of terms.

1.7 DELEGATED DESIGN

- A. Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers, equipment pads and supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
- C. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- D. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.8 WARRANTY

Deliver to the Government certificates of equipment warranty extending beyond the guarantee period.

PART 2 - PRODUCTS

2.1 FLASHING

- A. Flashing Material:
 - 1. 4-pound sheet lead.
- B. Counterflashing: 26 gage galvanized steel or 16-ounce soft sheet copper.

2.2 CONCRETE WORK

- A. Compressive Strength: 3000-psi minimum after 28 days.
- B. Reinforcing Steel: Yield strength as determined by structural design.
- C. Grout: Non-shrink, non-metallic, pre-mixed, equivalent to Nordbak Fast-set, U.S. Grout Five-star, or Polymeric.

2.3 BRICKWORK

- A. Brick: Sound, hard burned throughout, and of uniform size and quality.
- B. Mortar: One part masonry cement to three parts sand.

2.4 MOTORS AND ELECTRICALLY OPERATED EQUIPMENT

A. References, Characteristics and Ratings

1. Refer to Electrical Division for requirements of electrical work including starters specified in the Mechanical Division.
2. Provide motors and other equipment requiring electrical power or control service suitable for the electrical characteristics indicated on the Electrical Drawings.
3. Horsepower indicated is for manufacturer's equipment upon which the specification is based. Submit proposed deviations from these ratings for review by the COR. Pay costs incurred by deviations, which are permitted.
4. Provide motor rated for 200 volts for 208-volt service. Provide 230 and 460 volt rated motors for 240 and 480 volt service.
5. Brake horsepower rating at specified duty shall not exceed 85 percent of nameplate horsepower times NEMA service factor for motors with 1.15 service factor except where other limits are stated for certain equipment, i.e. fans and pumps, the maximum load percentage shall be as stated under that equipment times the 1.15 service factor. For water or refrigerant cooled motors driving compressors the maximum load percentage shall be 78 percent, 72 percent and 70 percent, for motors with 1.25, 1.35, and 1.4 service factors, respectively.
6. Motors controlled by variable speed drive (VSD) controllers shall be inverter type motors, compatible and suitable for operation with the VSD provided for this project.
 - a. Horsepower of VSD shall be same as motor.
 - b. Provide motor with a maintenance free, circumferential, conductive micro fiber shaft grounding ring equal to Electro Static Technology Aegis SGR bearing protection ring to discharge shaft currents to ground.

B. Overload Protection

1. Protect each motor, either individually mounted or in unitary equipment, with overload devices such as fuses, thermal cutouts, or thermal protectors installed in each ungrounded conductor serving each motor. Mount these overload devices in the motor controller or in a control panel in unitary equipment.
2. For equipment that requires the use of fuses, provide the proper size and type of fuses mounted on accessible fuse blocks, integral to the equipment, wired in accordance with applicable codes.

C. Construction

1. Construct motors in accordance with NEMA Standard Publication MG-1, latest edition, and the applicable IEEE standards.
2. Frame sizes in accordance with NEMA Standard MG-1 and MG-13, latest editions.
3. Starting torque, NEMA Design B, 2-4 percent slip.
4. Starting (locked rotor) kVA as required by the driven equipment. On motors with a locked rotor indicating code letter of "F" or higher, the manufacturer shall notify the electrical contractor for circuit breaker adjustment in accordance with Division 26, "Electrical."
5. Indoor, General Use: Open dripproof construction, 1.15 service factor.

- D. Insulation: NEMA Insulation Class B for operation in 104 degrees F ambient; except motors used in conjunction with variable speed drive controllers shall be NEMA Class F insulation with horsepower rating based on Class B rise.

Where motors operate in a maximum ambient temperature above 104 degrees F, provide motors suitably designed for the ambient temperature indicated, employing a different class of insulation or

having a change in frame size, i.e., the ambient temperature plus motor full load temperature rise plus 50 degrees F shall not exceed the temperature rating of the insulation system.

- E. Power Factor Correction Capacitors: Three-phase, rated for the applied circuit voltage, fused at 5 KVAR's and above. Employ non-PCB impregnated paper or film dielectric and insulation; installed in indoor dustproof NEMA Type 12, or outdoor NEMA Type 3R enclosure, depending on location; contain maximum of 3 gallons of a combustible insulating liquid; equipped with integral discharge resistors to reduce voltage to a maximum of 50 volts in three minutes.

Power factor correction capacitors shall be sized by the motor manufacturer. List the capacitor KVAR, the full load current of the motor-capacitor combination to enable proper sizing of the overload protection and the corrected power factor at no load and full load on the shop drawings for the equipment. Do not provide power factor correction capacitors for motors served by a variable speed drive or motors with reduced voltage starting. Do not provide power factor correction capacitors for pumps and fans that have dual motors mounted on a single common shaft and with other drive arrangements that rotate both motors.

1. Individual single speed, non-reversing motors, 5 HP and larger, having a full load power factor of less than 90 percent, shall be supplied by the equipment supplier, with power factor correcting capacitors that correct the full load power factor of the circuit to a minimum of 90 percent and the no load power factor to a maximum of unity.
 2. On single speed, non-reversing motors started by reduced voltage controllers such as star-delta, auto transformer, primary resistor, etc., provide necessary contactors and interlocks to prevent insertion of capacitor until controller and motor are operating in the full run mode. Full load power factor of the circuit shall be a minimum of 90 percent.
 3. Provide two speed motors with capacitors for the full speed mode. Provide necessary contactors and interlocks to permit insertion only on the full speed mode. Full load, full speed power factor of the circuit shall be a minimum of 90 percent.
 4. Provide power factor correction capacitors on chillers to correct power factor to a minimum of 90 percent when the chiller is operating at full load. The power factor correction capacitors shall be installed to the motor circuit between the starter and motor through the overload protection with wiring and overload sizing as recommended by the chiller manufacturer.
 - a. Install at the factory where available or provide components for field installation under supervision of the chiller manufacturer's representative.
 5. On package or unitized equipment on which motors and controls are factory wired up to a point or points of power connection, install and connect power factor correction capacitors to the motor circuits between the starters and the motors, as part of the factory supplied assembly.
- F. Single Phase Motors
1. 1/6 Horsepower or Less: Split phase capacitor start, permanent split capacitor or resistance start, capacitor run.
 2. 1/4 and 1/3 Horsepower: Capacitor starts.
 3. Bearings: "Life-time" sealed ball bearing type, oilable ball bearing or sleeve type.
 4. High efficiency energy saving type with a minimum efficiency of 70 percent and a minimum full load power factor of 77 percent.
- G. Three Phase Motors:
1. Premium efficiency polyphase induction type.

2. Minimum full load power factor before power factor correction of horizontal and vertical shaft motors shall be as follows:

HP	RPM	POWER FACTOR
3 to 250	3600 and 1800	85 Percent

3. Minimum efficiency (in percent) of horizontal and vertical shaft motors shall be follows:
 Open Dripproof (ODP) Motors

HP	1200 RPM	1800 RPM	3600 RPM
	Minimum Nominal Efficiency (%)	Minimum Nominal Efficiency (%)	Minimum Nominal Efficiency (%)
25	93.0	93.6	91.7
30	93.6	94.1	91.7
40	94.1	94.1	92.4
50	94.1	94.5	93.0
60	94.5	95.0	93.6
75	94.5	95.0	93.6
100	95.0	95.4	93.6
125	95.0	95.4	94.1
150	95.4	95.8	94.1
200	95.4	95.8	95.0

NOTE: Efficiencies are nameplate ratings and must be tested in accordance with IEEE Standard 112, Method B.

Totally Enclosed Fan Cooled (TEFC) or Explosionproof Motors

HP	1200 RPM	1800 RPM	3600 RPM
	Minimum Nominal Efficiency (%)	Minimum Nominal Efficiency (%)	Minimum Nominal Efficiency (%)
25	93.0	93.6	91.7
30	93.0	93.6	91.7
40	94.1	94.1	92.4
50	94.1	94.5	93.0
60	94.5	95.0	93.6
75	94.5	95.4	93.6
100	95.0	95.4	94.1
125	95.0	95.4	95.0
150	95.8	95.8	95.0
200	95.8	96.2	95.4

NOTE: Efficiencies are nameplate ratings and must be tested in accordance with IEEE Standard 112, Method B.

Measure motor efficiencies as tested in accordance with ANSI/IEEE Standard 112, Test Method B. Do not extrapolate efficiencies from other data. Measure each horsepower size. Submit test data from certified independent testing laboratory of standard manufacturer run per horsepower size.

H. Bearings and Bases

1. Motors 25 through 200 Horsepower: Anti-friction bearings sized for a minimum life of 25,000 hours under "V" belt load conditions or a minimum life of 100,000 hours for a direct connected load. House bearings in a regreaseable race with provision for purging old grease. Preload bearings with a bearing load spring to minimize noise and increase bearing life.
2. Motors for Belt Drive: Cast iron or steel base with slide rails having screw adjustments.

2.5 HANGER ATTACHMENT - Application and Type

- A. Concrete (New): Iron or steel inserts. Expander type anchors, specified for existing may be used provided concrete is clear of conduit for drilled depth.
- B. Concrete (Existing): Double plated expander type anchors. Phillips, Hilti or approved equivalent. Loads shall not exceed 1/4 of tested pullout (or shear) strength.
- C. Precast Concrete Plank: Drill hole through plank; bolt hanger rod to 4 by 4 by 1/8-inch plate on top of plank.
- D. Steel Beams: Iron or steel beam clamps.
- E. Cellular Metal Floor: Integral hanger support or insert type between cells. Do not pierce cells.
- F. Wood Beams: Light duty, screws; heavy duty, bolted bracket.
- G. Brick or Block Walls: Brackets fastened with self-drilling anchors or toggle bolts, light duty; or through bolts with backplates, heavy duty.

2.6 SLEEVES AND ESCUTCHEON PLATES

- A. Sleeves for Piping and Conduits - Material and Application
 1. Galvanized Standard Weight Steel Pipe with Anchor Flange Welded to Perimeter:
 - a. Exterior concrete walls.
 - b. Exterior masonry walls.
 - c. Roof vent stacks, which are flashed into stack terminal or terminal fitting.
 2. 22 Gage Galvanized Steel:
 - a. Stud partitions.
 - b. Suspended plaster and gypsum board ceilings.
- B. Escutcheon Plates for Piping: Chromeplated brass.
- C. Sleeves for Ductwork: 20 gage galvanized steel.
- D. Sealant

1. One part polysulfide, equivalent to Pecora Synthacaulk GC-9 or Proseal Ultratite 102 for general use.

E. Pipe Penetration Seals

1. Modular interlocking EPDM or silicone rubber links, dielectrically sealed to pipe and wall opening with pressure plates and bolts.
2. Link sealing elements shall be rated for pipe fluid temperature for each application.
3. Pressure plates shall be Delrin plastic or equivalent electrical insulating material.
4. Bolts and nuts shall be zinc phosphated low-carbon steel.

2.7 IDENTIFICATION

- A. Labels: WH Brady B-946 vinyl cloth pipe markers, 3/4-inch pipe banding tape with 1/2-inch wide tape to wrap the circumference of the pipe. Match color of tape with marker.
- B. Nameplates: Laminated phenolic plates, 1/8-inch thick, with beveled edges and engraved 1/4-inch high block, capital white letters on a black background. Provide laminated plates, 1/8-inch thick, with beveled edges and engraved 1/4-inch high white letters on red background for emergency instructions on sprinkler protection, fire protection, emergency generator starting, and other emergency operating instructions.
- C. Tags: Polished, lacquered, 1-1/2-inch diameter 18 gage solid polished brass tags with stamped letters or numerals 1/2-inch high, filled with black paint and fastened with brass "S" hooks or chains.
- D. Wire Markers: Self-sticking W. H. Brady Co. Perma Code wire markers.
- E. Flow Arrows: W.H. Brady Pipe Marker arrows Stock No. 91000 Series to identify the direction of flow in the pipe or duct. Match color with service marker for the system. One-inch arrow tape for marker Style 4; two-inch arrow tape for marker Style 1; four-inch arrow tape for marker Style 1HV; and Style 3C arrow tape for marker Style 3C.

PART 3 - EXECUTION

3.1 FLASHING

- A. Flash ducts, roof curbs, and pipes projecting through roof or outside walls. Extend flashing 12 inches into roofing materials. Make watertight seal to roof material and pipe and duct.
- B. Protect sleeve packing and flashing joints with counterflashing. Solder or weld counterflashing to pipe or duct. Clean joint and coat with zinc dust paint.

3.2 CONCRETE WORK

- A. Location: Equipment housekeeping pads, cradles or saddles pipes, vibration isolation inertia bases, and where indicated under mechanical and electrical work.

- B. Perform work in accordance with conformance to American Concrete Institute Standard ACI 301-72, Specifications for Structural Concrete for Buildings.
- C. Bond new work to existing concrete, by approved adhesive or by roughing existing surface to expose aggregate uniformly, then cleaning surface. Key new pads, piers, curbs, and pedestals to concrete floors using expansion bolts.
- D. Bevel exposed vertical and horizontal edges 3/4-inch.
- E. Install grout according to manufacturer's recommendations.
- F. Testing: Test concrete using a qualified testing agency.

3.3 BRICKWORK

- A. Location: Where indicated.
- B. Wet brick when laying. Lay in mortar so as to form full bed, end, and side joints in one operation. Maximum joint width, 3/8-inch, except when bricks are laid radially, narrowest part of joint shall not exceed 1/4-inch.
- C. Protect brick work from freezing and from drying effects of sun and wind.

3.4 MOTORS AND ELECTRICALLY OPERATED EQUIPMENT

- A. Align motor, drives, and driven equipment to avoid excessive strain or wear.
- B. Check belt tension with a tension tester for the deflection force recommended by the manufacturer. Check and adjust tension after several minutes operation and then after eight hours of operation.
- C. Power factor correction capacitors for individual motors are installed and connected under the Electrical Division. Coordinate with the Electrical Contractor.
- D. Install shaft grounding ring on shaft of motors served by variable speed drives in accordance with manufacturer's recommendations and instructions.

3.5 HANGER ATTACHMENT

Select and install structural attachments for hangers supporting pipes, ducts, and equipment adequately for stresses to which they may be subject and for proper distribution of load to building structural members.

3.6 SLEEVES AND ESCUTCHEON PLATES

- A. Sleeves are not required for core-drilled holes except where sleeves are specified and required to extend above the floor.
- B. Sleeves are not required for floor slabs on-grade.

- C. Install sleeves for pipes through walls, partitions, structural members, and other building parts. Install sleeves in time to permit construction progress as scheduled.
- D. Install sleeves for ducts passing through roofs as follows:
 - 1. Roof with waterproofing.
- E. Install sleeves with length to pass through full thickness of construction.
- F. Provide 1/2-inch minimum clearance between sleeve and pipe or duct. Center pipe or duct in sleeve unless otherwise indicated.
- G. Install ends of sleeves flush with finished wall surfaces.
- H. Reinforce sleeves temporarily, if necessary, to preserve accurate shape without distortion during construction.
- I. Grout sleeves into building structure to make joint watertight.
- J. Install escutcheon plates for pipes at walls.
 - 1. Fit escutcheons around insulation, or uninsulated pipe.
 - 2. Outside diameter shall cover sleeve.
 - 3. Where sleeve extends above finished floor, cover sleeve extension with escutcheon.
- J. Pack annular space between sleeve and pipe or duct, and voids between building construction and pipe, duct or sleeves as follows:
 - 1. Firestop equal to U.S. Gypsum Thermafiber, caulked at both ends to manufacturer's recommended depth with sealant, for the following sleeve locations:
 - a. Walls and partitions enclosing mechanical equipment rooms.
 - b. Roof and walls with waterproofing.
 - 2. For the following locations, pack annular space between sleeve and conduit, pipe, or duct and voids between building construction and pipe sleeves with industrial felt equal to U.S. Gypsum Thermafiber, caulked at both ends to manufacturer's recommended depth with sealant, or code approved firestopping foam, caulk, or putty that meets ASTM E-814 with UL classification sealant as specified in Division 07. Sealants shall not contain toxic or flammable solvents and shall not produce toxic or flammable outgassing during any stage of application, curing, drying or fire conditions.
 - a. Fire rated walls

See Section 23 07 00, "Mechanical Insulation," for fire stop insulation on pipes and ducts through sleeves.
- K. Vermin Control: Provide vermin control for pipes and duct passing through walls and roofs.
- L. Prime surfaces prior to caulking to obtain good adhesion where recommended by sealant manufacturer.

3.7 IDENTIFICATION

- A. Surfaces shall be cleaned and painted if specified, before applying markings.
- B. Place markings so that they are visible from the floor.
- C. Ductwork and Piping
 - 1. Apply labels and flow direction arrows on mains and principal branches of piping and ductwork. Wrap the circumference of pipe, overlapping both ends of each marker to give 360-degree identification. Mark each type of service every 25 feet with a minimum of one marking per room and additionally, at each side of penetration of walls, partitions and floors within one foot of penetration.
 - 2. Identify piping with Brady Marker Number as follows:

PIPING SERVICE	TEXT/BACKGROUND COLOR	MARKER NO. FOR PIPES
Chilled Water Return	White/Green	7046
Chilled Water Supply	White/Green	7047
Cold Water	White/Green	7084
Condenser Water Return	White Green	7068
Condenser Water Supply	White/Green	7069

- a. Provide Style 4 for pipes 1 to 2-1/2 inches, Style 1 for pipes 3 to 5 inches and Style 1HV for pipes 6 inches and larger. For pipes smaller than 1-inch, use same legend and color with Style 3C marker.
- b. Provide circumferential tape around both ends of marker to keep it in place.

Identify ductwork with Brady Marker labels as follows:

DUCTWORK SERVICE	TEXT/BACKGROUND COLOR	MARKER NO. FOR DUCT
General Exhaust	Black/Yellow	Custom

- D. Equipment
 - 1. Identify as to nature, services, system number or other designation by stenciling with letters 1-inch high and colored to contrast with background. Designate which items are main or standby.
 - 2. Equipment requiring identification.
 - Liquid Water Chillers
 - Flow Meters
 - Pumps
 - Variable Speed Drives
 - Exhaust Fan
- E. Secure nameplates to devices or adjacent surface.
- F. Valves, Regulators and Controls: Identify valves, regulators, controls, dampers and similar items, with tags. Valves adjacent to equipment they serve need not be tagged.
- G. Electrical Items

1. Identify disconnect switches, starting devices, controls, control switches, pushbutton stations with nameplates. Secure nameplate to device or adjacent surface with screws.
2. Identify control wires with wire markers.

H. Charts, Diagrams

1. Provide charts or diagrams of size and type as approved to enable quick identification, designating number, service or function, and location of each valve and fire alarm.
 - a. Include normal operating position (open, closed, or modulating).
2. Include outline plan of building indicating location and number of each riser, with its control valve.
3. Frame charts, and diagrams in approved wood or metal frames with clear glass front, secure to walls in location as directed.
4. Bind one copy of this information in the Operating and Maintenance Manual.

3.8 CONTRACTOR'S INSTALLATION DRAWINGS

- A. Submit, prior to installation of mechanical and plumbing systems, two copies of installation drawings (minimum scale - 1/2-inch = 1-foot [1:20]) of equipment rooms, corridors, shafts and any other crowded locations showing equipment, ductwork, piping, plumbing, electrical work, fire protection coordinated with each other and with the structure and, where relevant to this work, existing mechanical, plumbing, fire protection, and electrical services.
- B. These drawings shall not be construed as shop drawings that require review and action by the COR.
- C. Drawings shall show existing services where clearances for access are to be maintained.
- D. Relocate existing work or modify location of new work as required to maintain required access and code clearances.

3.9 PROJECT RECORD DOCUMENTS

- A. Maintain at the site one set of black or blue line on white prints of drawings, copies of specifications, addenda, shop drawings reviewed by COR, change orders and other modifications in good order and marked in red ink to record changes made during construction. Deliver these in final complete form to the Architect upon completion of work.
- B. Locate by dimension from the building walls, the exact location of piping, cable and other work that is buried before trenches are backfilled.

3.10 MATERIAL AND EQUIPMENT LIST

- A. Submit for COR's review a list of subcontractors' and manufacturers' names for items proposed for the work within 30 days after award of the contract.
- B. Failure to submit list or name manufacturers acceptable to COR within time limit will result in COR selecting a list of manufacturers, and selection shall be binding upon Contractor.

3.11 SHOP DRAWINGS AND DESCRIPTIVE DATA

- A. Submit six copies or more, if required by Division 01, of manufacturer's shop drawings and descriptive data.
- B. Establish that the physical and functional character of each item including, size, type and required service access is suited for its intended location and use.
- C. Coordinate drawings and data before submitting and certify that provisions of the contract documents have been met.
- D. Call attention, in writing, to deviations from contract requirements.
- E. Do not fabricate, deliver to site, or install items requiring shop drawing review, until the review has been completed by the Engineer and the shop drawing has been marked to indicate "No Exception Taken" or "Make Corrections Noted."
- F. Specifically identify pertinent project data on the shop drawings.
- G. Include Operation and Maintenance Data.
- H. Use only final or corrected drawings and data for construction.

3.12 SITE EXAMINATION

Failure to visit site and become familiar with local conditions prior to bidding will not relieve the Contractor of his responsibility for complying with the Contract Documents.

3.13 PERMITS

Obtain and pay for required permits.

3.14 CUTTING AND PATCHING

- A. Unless otherwise directed, do cutting and patching. Repair damaged fireproofing and waterproofing to original or better condition.
- B. Do not cut walls, floors, reinforced concrete or structural steel without COR's permission. Install services without affecting reinforcing steel.
- C. In precast concrete plank, drill holes with a carboloy tipped drill. Follow instructions of plank manufacturer. Cut no reinforcing bars.

3.15 CLEANING UP

- A. Keep premises free from accumulation of debris.
- B. Remove tools, scaffolding, surplus material, debris, and leave premises broom clean.

- C. On discontinuance of part of the work, place debris in containers and promptly remove them from the Government's property.

3.16 WORK IN EXISTING BUILDINGS

A. Conditions of Occupancy

1. This building will be occupied during the life of this contract. Execute work in a manner to impose minimal interference with the normal functioning of the building and its occupants. When interference is unavoidable, schedule work 14 days in advance with the COR.
2. Make temporary connections where necessary to maintain uninterrupted electrical, plumbing, and heating service.
3. Provide adequate protection for the building, its contents, and occupants.
4. Perform work as quietly as possible to avoid unnecessary disturbance. Unusual precaution may be necessary in the conduct or work in some areas to achieve satisfactory compliance.
5. Comply with regulations of Government pertaining to circulation, sanitation, and behavior of Contractor's personnel.
6. No impact driven piling shall be permitted. Minimum use of impact tools shall be limited to handheld tools and shall be scheduled 5 days in advance with Government.

B. Field Office, Storage, and Loading Facilities

1. Provide office and storage facilities in space on the site designated by the COR.
2. Provide adequate furnishings including file space, lighting, telephone, and heat where necessary.
3. Use only those toilet facilities designated by the COR for use by Contractor's personnel.
4. Store equipment and materials in areas designated by COR in a manner which will not (a) cause concentrations of weight potentially damaging to building structure, (b) impede normal building traffic, or (c) be a hazard to occupants.
5. Use only the entrance designated by the COR for delivery and removal of materials. Schedule deliveries and removals with the COR in advance. Unscheduled traffic must give precedence to COR's usage. Do not impede access through doorways and corridors with materials, containers, or parked conveyances.
6. Use only rubber wheeled wheelbarrows, dollies, or carts over finished floors.
7. Keep office, storage, and loading areas neat and clean.

C. Barricades

1. Erect temporary barriers for protection of occupants, building, and building contents.
2. Where partitions separating occupied areas must be cut, close hole with tight fitting temporary plywood closure panel, 1/2-inch minimum thickness, to form visual and acoustical barrier.
3. Protect exposed holes in floors in accordance with applicable codes and regulations.
4. Enclose dust-producing operations with plastic sheets or drop cloths to prevent the spread of dust into occupied areas. Maintain a negative pressure environment relative to the surrounding spaces.
 - a. Take the necessary precautions to prevent the spread of dust and dirt through the existing HVAC system, including outdoor intakes. Protect return and exhaust air openings.

D. Alterations

1. Cut, alter, remove or temporarily remove and replace existing work necessary for installation of mechanical and electrical work. Maintain the necessary clearances for accessibility or compliance with code around existing equipment, devices, etc., that are to remain.
2. Verify dimensions of existing building elements pertaining to the installation of new work to assure physical compatibility prior to fabrication or installation.
3. Where the installation of new services or the extension of existing services requires cutting of existing floors, walls, partitions, etc., check for the presence of existing mechanical and electrical services within or immediately beneath construction and exercise necessary precautions to prevent damage to the service or injury to personnel due to contact with same. Where practical, temporarily disconnect such existing service during the cutting operation. Schedule such outages in service with the COR, 14 days in advance.

E. Removal of Materials and Equipment

1. Remove promptly from the site, materials and equipment specified to be removed and not reinstalled or stored.
2. Unless otherwise indicated, removal of pipes, ducts, and equipment includes removal of accessories such as hangers, air outlets, piping connections, junction boxes, starters, etc. and all abandoned and non-operational mechanical system components within limits of the contract. Remove to source or, if concealed, to point of concealment, connections to mechanical equipment required to be removed or disconnected. Terminate connections behind finished surfaces and, if subject to movement, clear of building construction. Cap connections extending from ducts or piping remaining in service.

F. Connections to Existing Systems

1. Connect to existing systems as indicated.
2. Obtain permission from COR 14 days in advance if outage of service is necessary to make connections. See the Article titled, "Outages."
3. Repair insulation damaged at points of connection. Restore integrity of vapor barriers and surface finish.

3.17 PROTECTION

- A. Protect mechanical and electrical material and equipment from the elements or other injury as soon as delivered on premises. Protect plumbing fixtures as soon as they are set. Cover water closets and post notices prohibiting their use.
- B. Cap or plug openings in equipment, piping, duct, and conduit systems, to exclude dirt and other foreign material. Do not use rags, wool, cotton, paper, waste or similar materials for plugging.
- C. Existing components of the building and its systems shall be protected from damage. Any damage to these components shall be repaired or replaced to the satisfaction of the Government. Special care shall be taken with regards to insulation on existing piping and ductwork. Damaged insulation shall be replaced so that the vapor barrier and insulating characteristics of the material match those prior to damage taking place.

3.18 CLEANING OF SYSTEMS

- A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers, and other accessory items. Blow out and flush piping until interior are free of foreign matter.
- B. Flush piping in recirculating water systems to remove cutting oil, excess pipe joint compound, and other foreign materials. Provide necessary temporary pumping equipment to thoroughly clean the water piping. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the COR. Employ chemical cleaners, including a non-foaming detergent, not harmful to system components. Discharge flushing solution to sanitary piping system and not to floor drains connected to storm water systems. After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Work shall be performed or supervised by a qualified water treatment service company with personnel skilled in the safe and proper use of chemicals and in testing procedures. Submit a certificate of completion to COR stating name of service company used.
- C. Leave strainers and dirt pockets in clean condition.
- D. Clean fans and ductwork at completion of work.
- E. Pay for labor and materials required to locate and remove obstructions from systems clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.
- F. Leave systems clean, and in complete running order.

3.19 EQUIPMENT SUPPORTS

- A. Provide equipment supports consisting of platforms, curbs, concrete pads, gratings, cradles, structural members, hangers, rods, racks, and incidental materials.
- B. Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to properly distribute the load and impact over building areas.
- C. Concrete Equipment Pads
 - 1. Provide concrete pads not less than 4 inches high and projecting not less than 3 inches on all sides beyond equipment for floor mounted equipment.
 - 2. Place anchor bolts in steel pipe sleeves, with a plate at bottom end of sleeve to hold bolts.
 - 3. Grout between base plate and foundation.
- D. Floor Mounted Stands: Construct with structural steel members or steel pipe and fasten with flanges bolted to floor.
- E. Ceiling Suspended Platforms: Construct with steel hangers. Brace and fasten to building structure.
- F. Wall Mounted Platforms: Construct with steel brackets.
- G. Saddles for Tank Supports: Cast iron or welded steel of curvature to fit tank. Locate supports to avoid undue strain on shell and interference with pipe connections to tank outlets.

3.20 OPERATING AND MAINTENANCE MANUAL

- A. Furnish manual bound and indexed containing:
1. Brief description of each system and components.
 2. Starting and stopping procedures.
 3. Day/night changeover.
 4. Seasonal changeover
 5. Special operating instructions.
 6. Routine maintenance procedures.
 7. Schedule for periodic servicing and lubrication.
 8. Manufacturers' printed operating and maintenance instructions, parts lists, illustrations and diagrams.
 9. Manufacturers' Data Report Form U-1 certifying code compliance for equipment specified to be constructed in accordance with ASME Code for Unfired Pressure Vessels.
 10. One final or corrected reviewed copy of each shop drawing and Contractor's drawings.
 11. One copy of each wiring and piping diagram.
 12. One reviewed copy of certified test reports.
 13. Air and water balancing report.
 14. Product warranty information.
 15. Completed start-up report for the following equipment:
 - a. Liquid Water Chillers
 - b. Chilled Water Pumps
 - c. Exhaust Fans
- B. Submit to COR for review at least 30 days prior to date it is expected system will be turned over to Government.
- C. After review by COR, submit three copies to government and one to Engineer if Record.

3.21 FIELD INSTRUCTION

- A. Upon completion of work, instruct COR in the proper operation and maintenance of the mechanical and electrical systems.
- B. Instruction periods specified below shall be in addition to instructions specified for certain items elsewhere in the specifications.
- C. Instructions shall be given by persons expert in the operation and maintenance and shall be for a period of not less than 2 eight-hour days.
- D. Prepare statement(s) for signing by COR indicating date of completion of instructions and hours expended. Furnish copy of signed statement to COR.
- E. Training of the Government's operation and maintenance personnel is required in cooperation with the Commissioning Authority. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in cooperation with the Commissioning Authority after submission and approval of formal training plans. Refer to Section 01 77 00 Closeout Procedures, for contractor training requirements.

3.22 CONTRACTOR TESTS

Contractors' tests shall be scheduled and documented in accordance with the Commissioning requirements.

3.23 VERIFICATION TESTING

System verification testing is part of the Commissioning process. Verification testing shall be performed by the contractor and witnessed and documented by the Commissioning Authority.

3.24 OUTAGES

- A. The purpose of this article is to establish standard procedures for requesting an outage for mechanical, electrical, or operational systems or services associated with the physical plant.
- B. An outage is defined as prohibiting or restricting a mechanical, electrical or operational service from routine operation (see attached outage request for service included). For purposes of repair, replacement or connection to an existing system, this standard shall be followed.
- C. All persons requesting an outage shall complete an "Outage Request Form" included at the end of this Section.
- D. Contractor shall submit, in writing with the "Outage Request Forms" a plan on the work to be performed during the outage, including length of time and reason the utility system must be shutdown. Contractor, in conjunction with the Government, shall research and identify all systems affected by Outage as well as locating and listing all components by tag or facility equipment number, and all the action required at each to achieve the outage. Submit written Plan and Outage Form 14 days in advance of requested outage to Government.
- E. All "Outage Request Forms" and the Outage Plan shall be reviewed by the construction foreman or superintendent for feasibility and necessity.
- F. All systems, when shutdown, shall be tagged in accordance with OSHA and DGS lock-out/tag-out procedures.
- G. The number and duration of all outages shall be minimized.
- H. A master outage list, with the approximate required dates, shall be submitted to the Government within 14 days from the commencement of work.

Attachments: Outage Request Form

END OF SECTION 23 05 00

SECTION 23 05 48 - MECHANICAL SOUND AND VIBRATION CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

Vibration isolation devices, accessories, and supports to prevent transmission of vibration from mechanical equipment and distribution systems to building structure.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Section 23 05 00 - Basic Mechanical Materials and Methods
- C. Section 23 05 93 - Testing, Adjusting, and Balancing
- D. Section 23 20 00 - Building Services Piping
- E. Section 23 21 23 - Hydronic Pumps
- F. Section 23 64 16 - Liquid Water Chillers

1.3 QUALITY ASSURANCE

- A. The vibration isolator manufacturer's representative shall determine spring sizes and mountings, and shall provide field supervision and inspection to assure proper installation, adjustment and performance. The representative shall notify the Engineer of any isolator selections, which may experience resonance with the approved equipment, and upgrade any isolators that are found to resonate with the installed and operating supported equipment.
- B. Vibration isolation mounts, hangers, and equipment bases for Division 23 work shall be from the product line of a single manufacturer or products represented by the same manufacturer's representative.
- C. Work shall be performed by skilled workers who are experienced in the necessary workmanship to meet the requirements of this Section.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00.
- B. Vibration Isolation Product Data:
 - 1. Manufacturer's technical project data for each type of vibration isolation, including installation instructions, accessories, supports, bases, fittings, finishes, construction details and dimensions of components.
 - 2. System application for each type of vibration isolation.

3. Operation and Maintenance Data

C. Operation and Maintenance Data

1.5 APPLICABLE PUBLICATIONS

The publications form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

Schedule of Equipment Isolation is included in this Section.

1.7 VIBRATION ISOLATION MANUFACTURER'S RESPONSIBILITY

- A. Select vibration isolators, which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators. Determine vibration isolation sizes and locations.
- B. Furnish vibration isolation systems as specified.
- C. Guarantee specified isolation system deflection.
- D. Provide installation instructions, drawings and field supervision to assure proper installation and performance. The installation of all vibration isolation units and associated hangers and bases, shall be under the direct supervision of the manufacturer's representative. Upon completion of installation and after system is put into operation, representative shall make a final inspection and submit his report to COR in writing certifying correctness of installation and compliance with reviewed submittal data.

1.8 CONTRACT CLOSEOUT

- A. Provide the following in the Operating and Maintenance Manuals:
 - 1. Letter certifying that COR has been advised of all overstressed condition information.
 - 2. Final inspection report from manufacturer's representative.

PART 2 – PRODUCTS

2.1 VIBRATION ISOLATION DEVICES

- A. Select isolators for uniform static deflections according to distribution of weight and to meet requirements shown elsewhere in the Contract Documents.
- B. Select isolators for not less than the deflections indicated on the Schedule.
- C. Select vibration isolation for stable operation during starting and stopping of equipment without

excessive movement of equipment.

D. Bases

1. Provide rectangular bases, unless indicated otherwise.
2. Provide T or L shaped bases as required to support suction and discharge base elbows for horizontal split case pumps.
3. Provide perimeter side mounted unhooded isolators with brackets arranged for 1-1/2-inch clearance beneath base.

E. Corrosion Resistance: All springs and associated metal hardware shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated, or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc electroplated. Structural steel bases and exposed steel components of concrete inertia bases shall be cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.

F. Outdoor Locations: Steel parts PVC coated, hot-dip galvanized, zinc-electroplated plus coating of neoprene, bitumastic paint, or powdered coating. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts, and washers may be zinc-electroplated.

2.2 MOUNTINGS

A. Type A: Double deflection neoprene, friction surfaces on top and bottom, bolt holes, and threaded steel top inserts. Design for 0.25 - 0.35-inch deflection at rated load. Maximum hardness shall be 40 durometer. Color code to identify durometer. Except where rails are integral with equipment, provide steel rails to distribute load. Extend rails to compensate for overhang on close coupled pumps, small vent sets. Mason Industries Type ND.

B. Type B: Springs, free standing, laterally stable, without housing, 1/4-inch minimum thickness neoprene pads between baseplate and supports sized for deflection of 10-20 percent of unloaded pad height; leveling bolts. Spring diameters not less than 0.8 times compressed spring height at operating load. Springs shall have minimum additional travel to solid equal to 50 percent of operating deflection. Springs shall be designed so that the ratio of horizontal stiffness to vertical stiffness is approximately one. Mason Industries Type SLF.

2.3 BASES

Type N: Reinforced concrete base in structural channel frame. Minimum depth 6 inches, but not less than 0.085 times longest base dimension. Frame with reinforcing bars or angle base stiffeners welded in place running both ways in layer 1-1/2 inches above bottom with drilled steel members with sleeves to receive equipment anchor bolts. Base frame and reinforcement shall be furnished by isolator manufacturer of structural design suitable for indicated duty. Maximum spacing between isolators shall be ten times the depth of the base. Mason Industries base form Type K.

2.4 HOSES

A. Type T

1. Flexible single or double sphere type flanged connectors. Manufactured with multiple ply, nylon tire cord fabric that has an inner liner and outer cover of neoprene or EPDM. Sphere flange shall have an internal steel cord or band to prevent sphere separation from mounting installation flange. Working pressure shall be 150 psi at 220 degrees F for pipe sizes through 12 inches.
2. Sphere shall be suitable for application with unanchored piping with piping on isolation hangers and pumps on isolated base. Provide control rods or cables unless sphere is specifically designed and rated by the manufacturer for installation without control rods and cables. Provide installation instruction to clearly indicate if rods or cables are required and if pre-extension is required. This information shall be included in shop drawing submittal.
3. General Rubber 1010 single sphere.

2.5 ELASTOMERIC GROMMETS

Type U: Grommets shall be a separate bushing with a separate washer or combination neoprene washer/bushing. Grommets shall be formed to prevent bolts from directly contacting the secured item. Elastomer shall be 56 durometer maximum. Mason Industries Type HLB bushing with HLW washer or HG washer/bushing.

2.6 MANUFACTURERS

- A. Mountings and Bases: Amber-Booth, Kinetics Noise Control, Inc. Korfund, Mason Industries, Vibration Eliminator, Vibration Mountings and Controls, Vibrex.
- B. Hoses: Amber-Booth, General Rubber, Mason-Mercer Rubber, Metroflex.
- C. Grommets: EAR Specialty Composites Corp., Gates Molded Products, Mason Industries, Tech Products Corp., Vibration Mountings and Controls, Vibrex.

PART 3 – EXECUTION

3.1 VIBRATION ISOLATION DEVICES

- A. Install in accordance with manufacturer's recommendations. Corrosion coatings damaged during installation shall be repaired.
- B. Install isolators in locations to permit inspection and adjustment, and to provide proper operation. Install isolators as high as possible in hanger rod assembly, but clear of structure. Maintain 2-inch clearance between isolated equipment and walls, ceilings and other equipment. Maintain side clearance for hanger housings to allow a full 360-degree hanger rotation about the rod axis without contacting any object. Isolated systems shall be independently supported.
- C. Install isolators to provide 1-1/2-inch clearance between inertia base or frame and housekeeping pad. Keep clearance space completely clear of debris. Limit stops shall be out of contact during normal operation.
- D. Provide structural base plate under isolator where isolator is wider than supporting structural member. Tack weld plate to structural member.

- E. Mount equipment on steel base of adequate structural rigidity when equipment or frame is not structurally suitable for the type of isolation specified. Spring and rail and spring supports are specified on the basis that the equipment is structurally built or supported on a rigid frame. Isolators for equipment with bases shall be located on sides of the base, which are parallel to the equipment shaft.

3.2 EQUIPMENT ISOLATION SCHEDULE

- A. If the mount baseplate is bolted to structure or framework rigidly connected to the structure, Type U elastomeric grommets shall be used between each bolt and the baseplate to prevent rigid connection. These additional neoprene washers and bushings may be omitted if the baseplate and friction pad incorporate neoprene elements that eliminate rigid contact between bolts and the baseplate. Bolt holes shall be properly sized to allow for bushing sleeve. The anchor bolt shall incorporate steel washers to distribute load evenly over neoprene washers.

- B. Isolation Schedule

TYPE OF EQUIPMENT	SUPPORTING STRUCTURE			
	FLOOR SLAB ON EARTH		OTHER FLOOR AND ROOF	
	ISOLATION BASE TYPE	MIN. STATIC DEFLECTION IN INCHES	ISOLATION BASE TYPE	MIN. STATIC DEFLECTION IN INCHES
Rotary Screw & Scroll Unit	A	0.5	A	0.5
End Suction: Horizontal and Vertical Split Case (Base Mounted) and Vertical In-Line Pump				
thru 15 HP	B+N	1.0	B+N	1.0
20 HP and Up	B+N	1.0	B+N	1.75

3.3 PIPING ISOLATION

- A. Provide isolators for supports of all piping (except at anchor points and at base elbow supports for main risers) connected to vibration isolated equipment.
1. Throughout mechanical equipment rooms but, not less than 50 feet from the isolated equipment where the first 50 feet extends past the mechanical equipment room wall. The pipe shall not come in contact with the wall or sleeve.
 2. For the first 50 feet if not in a mechanical equipment room.
 3. Within 50 feet of pressure reducing valves.
 4. Between cooling tower and entrance into building.
- B. The minimum static deflection of the first three hangers shall equal that of the isolators supporting the equipment. Thereafter, provide isolators with 1/2 the static deflection capabilities of the isolation system of the equipment to which it is connected.
- C. Type A or B Mountings: Provide on all floor-supported piping.
- D. Type T Hoses: Provide on suction and discharge piping connection to vibration isolated floor-mounted Type AM, AP, BM, BP, CM, and CP pumps. Provide on piping connections to rotary screw and scroll refrigeration machines.

- E. The installation of vibration isolators shall not cause any change of position of piping, that will result in stresses in piping connections or misalignment of shafts or bearings. Account for changes in height and weight when pipes are filled with water.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 23 05 48

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Preparation, testing, adjusting, and balancing of mechanical equipment, water distribution and air distribution systems including inspection and certification reports.

1.2 RELATED DIVISIONS

- A. Division 01 - General Requirements
- B. Division 23 - Heating, Ventilating, and Air Conditioning

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with AABC National Standards.
- B. Certify that measurement instruments have been calibrated within 12 months prior to use on this project.
- C. Agency shall directly oversee work performed by it employing a competent supervisor subject to the approval of the COR.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00.
- B. Qualifications of Personnel
- C. List of Instrumentation and Instrumentation Certification Report
- D. Proposed Work Schedule Outline
- E. Equipment Installation Inspection Report(s)
- F. Testing, Adjusting and Balancing Report

1.5 APPLICABLE PUBLICATIONS

The publications form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

- A. Obtain applicable contract documents and copies of submittals for equipment and automatic control systems.
- B. After cleaning, prepare systems for proper operation. Systems shall be completely installed and in continuous operation before testing, adjusting and balancing (TAB) work is performed.

PART 2 - PRODUCTS

2.1 INSULATION REPAIR

Match original material type, vapor barrier jacket and thickness.

PART 3 - EXECUTION

3.1 INSULATION REPAIR

Repair insulation removed or damaged for TAB work.

3.2 INDEPENDENT TAB AGENCY

- A. Procure the services of a balancing and testing agency to perform the testing, adjustment and balancing (TAB) of equipment and water flows. Report instances in which the specified quantities cannot be provided by the installed equipment so that corrections to the equipment can be made under the section wherein it was specified.
- B. Add valves required for correct balance as recommended by the agency at no additional cost to Government. Submit such additions for COR's review.

3.3 TAB INSTRUMENTS

Calibrate instruments used for testing and balancing of air and hydronic systems within a period of 12 months prior to TAB. Submit final test analysis reports, including a letter of certification listing instrumentation used and last date of calibration.

3.4 TAB REPORTS

- A. Inspection reports covering equipment and systems installation shall be submitted during early stage of the project in order to allow timely correction of deficiencies.
- B. Follow check list format developed by AABC supplemented by narrative comments. Check for conformance with submittals.
- C. TAB reports covering flow balance, adjustments, and performance tests, working copy of reports shall be submitted as soon as TAB is performed for any necessary system evaluation.

- D. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
- E. Submit three copies of complete test reports for review.

3.5 TAB PROCEDURES

A. Balancing Objectives

- 1. Adjust and modify pumps or controls as required to produce design flow.
- 2. Adjust system for design exhaust air quantity.
- 3. Test and record cooling apparatus entering and leaving water temperatures.

B. Performance Tests

- 1. General: Conduct capacity tests on equipment. Conduct tests during a period of stable operations and minimum load fluctuation. Submit a performance report for each item tested which includes a comparison of installed capacity and specified capacity. Guidelines for the required tests and reports are as follows:
- 2. Chiller: For each chiller, measure and record the following information:
 - a. Entering and leaving chilled water temperatures.
 - b. Entering and leaving condenser water temperatures.
 - c. Water flow rates for both chilled and condenser water.
 - d. Refrigerant temperatures and pressures. Check super heat.
 - e. Compressor power input readings of volts and amperes in each phase.
 - f. Complete approved report form.
- 3. Pumps: After terminals have been balanced, determine total flow through the pump. Then:
 - a. Adjust flow rate to specified value or make recommendations for matching the pump impeller to give specified flow indicated by data measured.
 - b. Record pump operating suction and discharge pressures, pump speed, voltage, and amperage.
 - c. Complete approved report form.
- 4. Motors: Observe and record the following:
 - a. Voltage - nameplate versus measured.
 - b. Amperage - nameplate versus measured.
 - c. Motor speed.
 - d. Frame number.
 - e. Overload heater size.

3.6 TAB PHASING

- A. Coordinate TAB procedures with phase construction completion requirements for the project. Systems serving completed phases of the project will require TAB for such phases prior to partial acceptance and for final acceptance.

- B. Allow sufficient time in construction schedule for TAB and submission of reports prior to partial acceptance and for final acceptance.

3.7 EQUIPMENT INSTALLATION INSPECTION

An evaluation report shall be completed after air distribution equipment is on site and duct installation has begun, but in advance of performance testing and balancing work. Identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.

3.8 TAB REQUIREMENTS

- A. Provide TAB for equipment and motors including performance tests as required in applicable sections of Division 23.
- B. During final TAB, related systems shall be in full operation.
- C. Test and balance systems in all specified modes of operation. Verify that controls function properly.
- D. Balance variable primary flow systems at design flow and verify that variable flow controls function properly.
- E. Operating Tests: Demonstrate to COR the specified performance of systems and components.

3.9 RENOVATION WORK REQUIREMENTS

Prior to start of construction, obtain GPM flow from existing flow meters in chilled water system for renovated area. Information obtained shall be provided to Engineer when reading is obtained.

3.10 COORDINATION WITH THE AUTOMATIC CONTROL SUBCONTRACTOR

The Automatic Control System (ACS) Subcontractor shall put the system in the required mode of operation as requested by the Testing and Balancing (TAB) Subcontractor. All programming changes and reporting of data from the Building Automation System (BAS) needed to achieve proper performance shall be done by the ACS Subcontractor. The TAB Subcontractor shall be the lead Subcontractor in coordinating his work and the ACS Subcontractor's work. All work is by the TAB Subcontractor unless noted as being the responsibility of the ACS Subcontractor.

END OF SECTION 23 05 93

SECTION 23 07 00 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Insulation for piping and equipment specified in Division 23.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Section 23 05 00 - Basic Mechanical Materials and Methods
- C. Section 23 20 00 - Building Services Piping
- D. Section 23 21 16 - Hydronic Piping Specialties
- E. Section 23 21 23 - Hydronic Pumps
- F. Section 23 64 16 - Liquid Water Chillers

1.3 QUALITY ASSURANCE

- A. Unless otherwise noted, pipe insulation shall have a K value insulation conductivity Btu inch/hour-ft² degrees F in accordance with ASHRAE 90.1, latest version.
- B. Insulation on pipes through floors, fire rated walls, and smoke barriers shall be UL listed fire-stop insulation to maintain fire resistance of the floor, fire rated wall, or smoke barrier in accordance with NFPA 101.
- C. Canvas covering shall be flame and mildew proof.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00.
- B. Each type of insulation: Manufacturer and product designation, surface burning characteristics, thickness, density in pounds in accordance with cubic foot thermal conductivity or R-value, jackets (factory and field applied), and accessories.
- C. System application for each type of insulation.
- D. Statement of compliance with ASHRAE 90.1, latest version.
- E. Statement of compliance with NFPA 90A, flame spread index and smoke developed index requirements.

- F. Statement of compliance with National Architectural and Industrial Maintenance Rule for VOC levels on Adhesives, Mastics, and Coatings for the State of Maryland.
- G. Statement of compliance with Ozone Transport Commission for VOC levels on Adhesives, Mastics, and Coatings for the State of Maryland.

1.5 APPLICABLE PUBLICATIONS

The publications form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

- A. Where insulation must be stored outdoors, provide polyethylene film cover for protection. Insulation that becomes wet shall be replaced; drying of insulation is not acceptable.
- B. Coordinate clearance requirements for insulation application with pipe and equipment installation.

PART 2 - PRODUCTS

2.1 GENERAL MATERIAL REQUIREMENTS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products shall comply with the National Architectural and Industrial Maintenance (AIM) Rule for VOC levels for the State of Maryland.
- C. Products shall comply with the Ozone Transport Commission limits for VOC levels for the State of Maryland.

2.2 ADHESIVES, MASTICS, COATINGS

A. Adhesives

1. Type A1

- a. High tack, rapid setting water-based adhesive.
- b. Solvent free, low VOC (0.03 pounds/gallon) synthetic elastomer emulsion.
- c. Non-flammable when wet and fire-resistive when dry.
- d. Moisture resistant.
- e. Flame spread index 0 and smoke developed index 0.
- f. Asbestos, lead, and mercury free.
- g. ASTM C916 Type 11.

B. Mastics

1. Type M1

- a. White, flexible, water-based vapor barrier mastic.
- b. Low VOC (0.3 pounds/gallon).
- c. Non-flammable when wet and fire-resistive when dry.
- d. Water resistant and low water vapor permeance.
- e. Flame spread index 5 and smoke developed index 25.
- f. Asbestos, lead, and mercury free.
- g. MIL-C-19565C, Type II.

2. Type M3

- a. White, flexible, elastomeric coating.
- b. Vapor barrier for outdoor application, chemical resistant, and UV and sunlight resistance.
- c. Fire resistant.
- d. Flame spread index 10 and smoke developed index 15.
- e. Asbestos, lead, and mercury free.

C. Coatings

1. Type C1

- a. White, washable, abrasion-resistant coating.
- b. Low VOC (0.13 pounds/gallon).
- c. Fire resistant.
- d. Flame spread index 10 and smoke developed index 5.
- e. Asbestos, lead, and mercury free.

D. Manufacturers: Childers, Foster, Mon-Eco Industries.

2.3 INSULATION TYPES

A. Type A

1. Insulation: Sectional molded glass fiber pipe insulation. Minimum density: 3.0 pounds per cubic foot meeting ASTM C547 Standard Specifications for Mineral Fiber Pipe Insulation of Type I.
2. Factory Applied Jacket: White, flame retardant vapor barrier jacket of 0.001-inch aluminum foil laminated to kraft paper reinforced with glass fibers, or all-service jacket.
3. Insulated Fitting Covers: Insulation insert with PVC cover equivalent to Zeston.
4. Manufacturers: Johns-Manville, Knauf, Owens-Corning.
5. Polyguard RG-CW or approved equal mineralization coating for application to the interior surface of the insulation.

B. Type C

1. Insulation: Flexible, closed-cell elastomeric pipe insulation equal to AP Armaflex or AP Armaflex SS, ASTM C534. Minimum Density - 5 pounds in accordance with cubic foot.
2. Material shall have a flame spread index of 25 or less and a smoke developed index of 50 or less as tested by ASTM E84.
3. Suitable for temperatures 0 to 220 degrees F.

4. Maximum moisture vapor transmission of 0.08 perms.
5. Manufacturers: Armacell, Rubatex.

C. Type D

1. Insulation: Flexible, unfaced glass fiber blanket. Minimum Density - 3/4 pound per cubic foot. Layer Thickness - 1/2-inch meeting ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for commercial and industrial applications.
2. Manufacturers: Johns-Manville, Knauf, Owens-Corning.

D. Type G

1. Insulation: Rigid glass fiberboard. Minimum density - 6 pounds per cubic foot meeting ASTM C 612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
2. Factory Applied Jacket: White vapor retardant barrier jacket minimum 0.001-inch aluminum foil reinforced with glass fiber bonded to flame resistant kraft paper.
3. Maximum moisture vapor transmission of 0.02 perms.
4. Corner Bead: Childers No. 3 Super Evon.
5. Manufacturers: Certain-Teed, Johns-Manville, Knauf, Owens-Corning.

E. Type K

1. Insulation: Flexible, closed-cell elastomeric sheet insulation equal to AP Armaflex or AP Armaflex SA. Minimum density - 5 pounds per cubic foot.
2. Material shall have a flame spread index of 25 or less and a smoke developed index of 50 or less as tested by ASTM E84.
3. Suitable for temperatures 0 to 220 degrees F.
4. Maximum moisture vapor transmission of 0.08 perms.
5. Manufacturers: Armacell, Rubatex.

F. Type L

1. Insulation: Flexible, closed-cell elastomeric sheet insulation equal to AP Armaflex. Minimum density - 5 pounds per cubic foot.
2. Material shall have a flame spread index of 25 or less and a smoke developed index of 50 or less as tested by ASTM E84.
3. Suitable for temperatures 0 to 220 degrees F.
4. Enclosure: 18 gage galvanized steel.
5. Manufacturers: Armacell, Rubatex.

PART 3 - EXECUTION

3.1 GENERAL PREPARATION AND APPLICATION REQUIREMENTS

- A. Complete piping and equipment tests before insulation is applied.
- B. Clean and dry surfaces to be insulated of loose scale, dirt, oil, water and other foreign matter.
- C. Insulate completely metal surfaces of piping and equipment other than hangers as delineated under Extent of Insulation.

- D. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- E. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- F. Install insulation with least number of joints practical.
- G. Permit expansion and contraction without causing damage to insulation or surface finish.
- H. Extend surface finish to protect surfaces, ends, and raw edges of insulation.
- I. Fire-stop insulation shall be continuous to 6 inches on either side of barrier. Seal jacket seam and end joints to adjacent sections of insulation for continuous vapor barrier. Annular space between insulation and sleeve shall be sealed as specified in Section 23 05 00, "Basic Mechanical Materials and Methods," in the Article titled, "Sleeves and Escutcheon Plates."
- J. Provide vapor retarding barriers continuous and uninterrupted throughout the system where specified, except where insulation is interrupted for fire dampers.
- K. Where connections are made to existing systems, provide insulation as specified and to match existing where existing insulation is removed or damaged for new connection. Provide vapor barrier continuously sealed to the existing insulation.
- L. 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.
- M. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- N. Install multiple layers of insulation with longitudinal and end seams staggered.
- O. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- P. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet.
- Q. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- S. 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 similar to butt joints.
- T. Penetrations
 - 1. Exterior Wall Penetrations: Install insulation continuously through penetrations.
 - a. Seal penetrations with flashing sealant.

- b. For applications requiring only indoor insulation, terminate insulation at inside wall surface for wall penetrations. Seal with joint sealant.
 - c. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - d. Extend jacket of outdoor insulation outside wall flashing for wall penetrations and overlap wall flashing at least 2 inches.
 2. Non-Fire Rated Interior Floor, Wall and Partition Penetrations: Install insulation continuously through floors, walls and partitions.
 3. Fire-Rated Floor, Wall and Partition Penetrations:
 - a. Seal penetrations through fire-rated assemblies according to Division 07, Penetration Firestopping.
- U. Coordinate insulation installation with installation of heat tracing. Comply with requirements for heat tracing that apply to insulation.
- V. Piping
 1. Insulate valves, strainers and fittings, including unions and flanges. For the purpose of this specification, fittings include unions and flanges. Install insulation with continuous thermal and vapor retardant integrity, unless otherwise noted. Use premolded material where available.
 2. Insulate valve bodies and flanges up to and including bonnets, except for chilled water valves. Insulate over packing nuts in a manner to permit removal for adjustment and repacking of chilled water valves.
 3. Insulate strainers in a manner to permit removal of the basket without disturbing the insulation of the strainer.
 4. Fill hollow interior of protection saddles with insulating cement.
- W. Equipment
 1. Cut or score insulation to fit shape and contour of equipment. Bevel insulation edges for cylindrical surfaces for tight joints.
 2. Stagger end joints.
 3. Provide permanently fastened angles or plates, where required, to support insulation. Protect exposed corners with secured corner angles.
 4. Do not weld anchor pins to ASME-labeled pressure vessels.
 5. Apply insulation on access opening and cover plates as separate sections, with insulation cut back for access to bolt heads and other fasteners. Bevel and seal insulation ends around manholes, handholes, and ASME stamps.
 6. Do not cover nameplates. Cut back the insulation, bevel, seal, and line edges with 24-gage galvanized steel.
 7. Insulate skirts, cradles, legs and other supports of vessels storing materials at 60 degrees F or lower temperature for a distance away from the vessel four times the thickness of the insulating material same as the vessel.
- X. Vermin Proofing: Wherever insulated piping pass through sleeves or openings which are required to be vermin proof, provide sections of foamed glass insulation equal in length to length of sleeves. Refer to Section 23 05 00, "Basic Mechanical Materials and Methods," in the Article titled, "Sleeves and Escutcheon Plates" for details and extent of vermin proofing.

3.2 ADHESIVES, MASTICS, COATINGS

- A. Apply adhesives, mastics and coatings at the rate of coverage and in a manner recommended by the manufacturer.
- B. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise noted.

3.3 INSULATION TYPES

A. Type A

1. Application

- a. Pipe: Fit insulation to pipe, staggering longitudinal joints. Seal longitudinal joint overlaps with 4-inch wide sealing strips of vapor barrier jacket material applied on circumferential joints with Type A1 adhesive.
- b. Fittings and Valves: Apply fabricated or premolded insulated fitting covers or insulating cement equal in thickness and density to adjoining pipe insulation. Seal with a 1/16-inch thick coat of Type M1 mastic for cold water lines. Seal with a 1/16-inch thick coat of Type C1 coating for hot lines. Imbed a layer of glass fiber fitting tape in the mastic or coating and after the initial coat has dried, apply an additional 1/16-inch coat of mastic or coating.

2. Surface Finish

a. All piping.

1) Pipe

- a) Standard duty, concealed and exposed – no additional finish required.

2) Fittings and Valves:

- a) Standard Duty – no additional finish required.

b. For piping outdoors:

- 1) Apply two 1/16-inch thick coats of white Type M3 mastic with a glass reinforcing fabric (1-1/2 ounce minimum) between coats, lapping joints a minimum of 2 inches to form a weatherproof finish.
- 2) Alternate: Apply 0.016-inch aluminum metal jacket with vapor barrier. Place preformed 2-inch butt strap with sealant over seams and secure with 1/2-inch aluminum band and wing seal.

- 3. Chilled Water Piping: Coat inside of insulation with mineralization coating. Apply coating to inside core of insulation simultaneously with the installation of the insulation and rotate onto the pipe.

B. Type C

1. Pipe: Slip the insulation over the pipe wherever possible or slit the insulation sections and apply around the pipe. Seal seams and joints with insulation manufacturer's adhesive.
 2. Fittings, Valves: Fabricate segments of insulation, miter joints. Seal with special adhesive.
- C. Type D
1. Wrap two or more layers as required for thickness specified firmly around pipe bundle.
 2. Secure with cord tied on 9-inch centers.
 3. Cover insulation with 45-pound roofing felt secured with bands or wire. Option - 0.016-inch aluminum jacket for piping not in trenches.
- D. Type G
1. Application
 - a. Secure insulation with pins welded or adhered to sheet metal on 15-inch centers. Cut side pieces of insulation to lap top and bottom pieces. Apply Type A1 adhesive to entire underside of horizontal metal surfaces. Secure 1-1/2-inch diameter fiber or tin-coated disk to pins.
 - b. Protect outer corners of insulation with 3 by 3-inch aluminum angles or roll-on corner bead.
 - c. Butt insulation joints, seal with 4-inch vapor barrier foil tape or 2-inch laps adhered with Type A1 adhesive. Seal over penetrations and disks with tape or Type M1 mastic.
 2. Surface Finish
 - a. Imbed glass-reinforcing fabric, 20 by 20 mesh (1-1/2-ounce minimum) in tack coat of Type C1 coating (2 gallons in accordance with 100-square-foot) lapping joints a minimum of 2 inches.
 - b. Finish when dry with final coat of Type C1 coating (4 gallons in accordance with 100-square-foot).
- E. Type K
1. Application
 - a. Secure insulation to equipment with smooth side out using insulation manufacturer's adhesive on both contacting surfaces for Type AP Armaflex.
 - b. Fill joints with insulation manufacturer's adhesive.
 - c. Apply layers with staggered seams secured with insulation manufacturer's adhesive where necessary to obtain specified thickness.
 2. Surface Finish: Apply two coats of insulation manufacturer's protective finish as recommended by manufacturer.
- F. Type L
1. Line enclosure with sheet insulation. Fasten to equipment with bolts and provide lifting handles for removal without damage to insulation or enclosure. Submit details of enclosure design for Engineer's review before fabrication.
 2. Fill joints with adhesive.

3. Apply layers with staggered seams secured with adhesive where required to obtain specified thickness.

3.4 FIELD APPLIED JACKETS

A. PVC Jacket

1. High-impact resistant, UV-resistant PVC complying with ASTM D 1784, Standard Specification for Rigid Polyvinyl Chloride (PVC) compounds and Chlorinated Polyvinyl Chloride (CPVC) compounds. and Class 16354-C; 30 mils thick, roll stock ready for shop or field cutting and forming.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White Color-coded jackets based on system.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
5. Manufacturers: Johns Manville; P.I.C. Plastics, Inc.; Proto Corporation; Speedline Corporation.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.
6. Manufacturers: ABI, Compac Corporation, Venture Tape.

C. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications; adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Manufacturers: Dow Corning Corporation 739, Dow Silicone; Johns Manville Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive; P.I.C. Plastics, Inc. Welding Adhesive; Speedline Corporation Polyco VP Adhesive.

D. Where PVC jackets are used, install with 1-inch overlap at longitudinal seams and end joints for horizontal applications. 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.

3.5 INSTALLATION SCHEDULE

A. Piping

PIPING SYSTEM	MATERIAL TYPE	INSULATION THICKNESS IN INCHES FOR PIPE SIZE				
		Less than 1"	1 to less than 1-1/2"	1-1/2 to less than 4"	4 to less than 8"	8" & Larger

PIPING SYSTEM	MATERIAL TYPE	INSULATION THICKNESS IN INCHES FOR PIPE SIZE				
		Less than 1"	1 to less than 1-1/2"	1-1/2 to less than 4"	4 to less than 8"	8" & Larger
Electric Heat Traced Piping (Note 5)	A	1	1	1	1	1-1/2
Electric Heat Traced Piping (insulated as a bundle)	D	1	1-1/2	1-1/2	2	2-1/2
Chilled Water (40°F and above) (Note 2)	A	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2
Domestic Cold Water (Note 6)	A,C	1/2	1/2	1	1	1

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B. Equipment

EQUIPMENT	MATERIAL TYPE	INSULATION THICKNESS (INCHES)
Chilled Water Pumps	G	2
Water Chiller Components		
Evaporator Shell	K	1-1/2
Evaporator Water Boxes	L	1-1/2
Feet	K	1
Suction Piping & Cold Section of Compressor	K	2
Motor on Water Cooled Models	K	1

Note 1: Not used.

Note 2: Locate hangers outside of insulation with saddles or thermal shields specified under another section. In the saddle, provide a half section of calcium silicate or foam glass equal in thickness to adjoining insulation, sized to carry load without crushing, and vapor sealed. Insulate supports and anchors in contact with pipe the same as piping.

Note 3: Not used.

Note 4: Not used.

Note 5: Indicated thickness is additional to that specified for the particular piping system. Apply over heat tracing.

Note 6: Type C may be used in lieu of Type A, where indicated, at Contractor's option, for pipes up through 2-inch except where heavy-duty finish is required.

3.6 EXTENT OF INSULATION

A. Piping: Insulate as designated in Installation Schedule.

- B. Equipment: Insulate as designated in Installation Schedule.
- C. Chilled water pumps shall be insulated by forming a box around the pump housing. The box shall conform to the requirements of MICA National Insulation Standard 1993, Fourth Edition, Plate 49 except insulation shall be as specified in this section. The box shall be constructed by forming the bottom and sides using joints, which do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing, which does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable. Two coats of Type M3 mastic shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Exposed insulation corners shall be protected with corner angles. The total dry thickness of the finish shall be 1/16-inch. Caulking shall be applied to parting line of the removable sections and penetrations.

END OF SECTION 23 07 00

SECTION 23 09 23 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Complete automatic control system as required for automatic operation of heating, ventilating and air conditioning systems including controllers, operators, valves, control cabinets, control center, and accessories.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Section 23 05 00 - Basic Mechanical Materials and Methods
- C. Section 23 05 93 - Testing, Adjusting, and Balancing
- D. Section 23 20 00 - Building Services Piping
- E. Section 23 31 13 - Duct and Duct Accessories
- F. Section 23 34 16 - Fans
- G. Section 23 64 16 - Liquid Water Chillers
- H. Section 26 05 00 - Basic Electrical Materials and Methods

1.3 QUALITY ASSURANCE

- A. Automatic control system contractor must be a direct, wholly owned, branch of the controls manufacturer, not a representative or a distributor.
- B. Electrical work shall comply with NFPA 70, National Electrical Code.
- C. Digital Control System
 - 1. The automatic control system shall be an open architecture system with native BACnet Architecture.
 - 2. Digital system controller shall be a UL approved signaling system and shall comply with the latest Federal Communications Commission regulations.
 - 3. The automatic control system subcontractor shall be responsible for quantity and type of controllers to make the DDC system fully operational.
- D. Controls, operators, setups and components shall be provided under this section to provide a system capable of operating as defined in the sequence of operations indicated on the drawings.

- E. Automatic control system subcontractor shall be responsible for providing quantity and type of transformers to make their system operational, except for equipment where transformers are furnished and mounted by the equipment manufacturer.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Sections 23 05 00.
- B. Schematic wiring and control diagrams including graphic system representation, operating sequences, and control description for entire system.
- C. Valve schedule.
- D. Refrigerant Monitors.

1.5 APPLICABLE PUBLICATIONS

The publications form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

PART 2 - PRODUCTS

2.1 AUTOMATIC CONTROL SYSTEM

- A. Automatic control system shall be direct digital control with electronic or electric control, electric actuation complete with necessary electrical interlocks, protective devices and associated control wiring.
- B. Control shall be performed by a field programmable Digital System Controller (DSC), microprocessor based, which incorporates direct digital control, energy management functions, and provides for digital display and local adjustments of desired variables at the control cabinet.
- C. Controllers, operators, panels, and other control devices shall generally be the standard product of one manufacturer.
- D. Manufacturers: Automated Logic, Honeywell, Invensys, Johnson Controls, Siemens Building Technologies, Inc. (Landis Division).

2.2 CONTROLLERS

- A. Type: Proportional or positive action (for on-off control) with adjustable set point and modulating range or differential. Controllers, mounted on control panels, shall be remote sensing.
- B. Controllers for chilled water supply temperature and elsewhere as indicated shall be PID adjusted for stable modulating range, yet limiting deviation from control point of 1 degree F.

2.3 OPERATORS

- A. Operators shall return to open or closed position as required to minimize possibilities of freezing, system malfunction or overheating upon system shutdown, changeover, or power failure.
- B. Operators shall be quiet and have ample power to provide smooth, repeatable proportional positioning under all operating conditions, and shall be rated to allow for motor, or valve deterioration.
- C. Sequencing of operation for DDC systems shall be software programmable.

2.4 VALVES

- A. Globe or angle pattern unless otherwise indicated rated for 125 psig working pressure. Where butterfly valves are indicated, they shall conform to valve specification in Section 23 20 00, "Building Services Piping."
- B. 2-1/2-inch and larger IBBM, flanged connection; 2-inch through 3/4-inch, brass or bronze screwed, union connection; 1/2-inch and smaller, flared connections.
- C. Teflon or synthetic rubber packing suitable for extremes of system temperatures and pressures.
- D. Furnish single seated valves with renewable discs or seats, except valves serving individual terminal units.
- E. Characteristics: Select for optimum performance for indicated service.
- F. Maximum Pressure Loss
 - 1. Water Service: Heat exchanger including coil modulating control, 10 feet w.g. or pressure drop of exchanger, whichever is greater.
 - 2. Water Service: System modulating control, including secondary circuit mixing, 10 feet w.g.

2.5 CONTROL CABINETS

- A. Finish: Grey, beige, or green, mat surface.
- B. Provide nameplates identifying controls and unit or system.
- C. Wiring: Prewire all panel wiring terminating at concealed terminal strip.

2.6 ELECTRIC WIRING AND CONTROL

- A. Electrical work shall conform to the Electric Division requirements except as modified below.
- B. Minimum wire size shall conform to NFPA 70 (National Electrical Code) requirements.

- C. Minimum Conduit Size: Trade size 3/4-inch. Conduit mounted outdoors or in damp areas shall be rigid.
- D. Class 1 Wiring (Greater than 30 volts): Install in conduit in accordance with NFPA 70 (National Electrical Code).
- E. Class 2 Wiring (30 volts or less): Remote control and signal wiring may be run in multi-conductor cable with PVC insulation, Mylar binder and PVC jacket. Digital transmission shall be through twisted, shielded pair. Entire installation shall be in accordance with NFPA 70 (National Electrical Code), and shall meet additional requirements noted.
- F. Cables carrying AC circuits sensitive to external fields shall be shielded.
- G. Material installed in ceiling plenums used to transport air shall meet applicable code requirements.
- H. Furnish control transformers with steel enclosures with separate primary and secondary compartments, each with conduit connections.
- I. Secondary side of control transformer shall be fused.

2.7 CONTROL CENTER

- A. The control center shall be PC based and include the following Energy Star labeled equipment:
 - PC: 64-bit operating system, x64-based processor Min 3.5 GHz 250 gigabit hard drive; 32 GB RAM.
 - Keyboard
 - Graphic Color Display Monitor: 21-inch
 - Mouse
 - Surge Protection
 - Battery Backup
 - Color Printer
- B. The control center shall be capable of performing the following functions:
 - Monitoring
 - Energy Management
 - Operator Interface
 - Programmable
 - Expandable
 - Self-diagnostics
 - Default Operating Procedures
 - Alarms
 - Remote Communications
 - Remote Control Point Adjustment
 - Graphic Panels
- C. The control center shall have reporting capabilities definable and changeable by the operator. Automatic report generation capabilities shall be included.

2.8 DIRECT DIGITAL SYSTEM

- A. The digital system controller (DSC) shall perform its assigned control and energy management functions as a standalone unit. The DSC shall also provide for user interface through a standard web browser. The building automation system's full feature set shall be accessible through web browser. The web browser shall be capable of being set up to access the controller directly over the IP network or through the Internet or public telephone service for remote operation and system fault diagnosis. Contractor shall provide all hardware and/or software required to allow for complete user access to system through web browser. The DSC shall perform its full control and energy management functions regardless of condition of communications link with the building automation system. These stand-alone capabilities shall include, but not be limited to, the following:
1. Control Functions:
 - a. Closed loop control functions (P, PI, PID, Incremental, Floating, etc.).
 - b. Energy management functions, including but not limited to:
 - Economizer Control
 - Supply Air Reset
 - Supply Water Reset
 - Adaptive Optimal Start
 - Chiller Optimization
 - Duty Cycling
 - Demand Limiting
 - Event Initiated Programs
 2. Control:
 - a. Control algorithms shall be available and resident in the DSC to permit proportional, integral, and derivative control modes in any combination to meet the needs of the application. Other control modes, such as incremental, floating, or two position, shall be available to adapt to job needs.
 - b. Control shall be performed in a digital manner, using the digital signal from the microprocessor-based controller converted through electronic circuitry for modulation of electric actuators.
 3. Energy Management: DSC shall be capable of performing the energy management functions indicated.
 4. Operator Interface:
 - a. The building control system shall permit full operator communication including:
 - (1) Obtaining information about the performance of the system.
 - (2) Allowing the operator to change the system operation diagnosing system malfunctions.
 - (3) Operator communication through the use of any of the following operator terminals:
 - PC
 - Laptop

- b. It shall be possible to have one operator's terminal at each stand-alone control unit, or to have a single operator's device which can be connected to any panel in the network. The building control system shall permit complete operation of any stand-alone control unit within the network, from any operator terminal within the system.
 - c. Adjustments of control variable shall be available at the controller. These adjustments shall include, but not be limited to:
 - Proportional Gain
 - Integral Rate
 - Velocity and Acceleration Constants Associated with Incremental Control
 - On/Off Values of Two-Position Control
 - d. Access to programs and points shall be password controlled.
5. Field Programmable: The controller shall contain necessary mathematics, logic, utility functions, and standard energy calculations and control functions in ROM to be available in any combination for field programming the unit. These routines shall include, but not be limited to:
- a. Math Routines:
 - Basic Arithmetic
 - Binary Logic
 - Relational Logic
 - Fixed Formulas for Psychometric Calculations
 - b. Utility Routines:
 - Process Entry and Exit
 - Keyboard Functions
 - Variable Adjustments and Output
 - Alarm Indication
 - Restart
 - c. Control Routines:
 - Signal Compensation
 - Loop Control
 - Energy Conservation
 - Timed Programming
 - d. Final field programming shall be stored in battery backed-up RAM.
6. Expandability: The DSC shall be expandable by adding additional field interface units that operate through the processor of the DSC. The processor in the DSC shall be able to manage the remote field interface units, thereby expanding its control loop and energy management point capacity.
7. Calibration Compensation: To maintain long term analog accuracy in the controller sensing circuits, the DSC shall sense the voltage being supplied to the resistance

- sensing element and, through firmware, compensate for power supply changes due to long term drift, or drift due to ambient temperature changes at the power supply.
8. Battery Backup: Provide a minimum of 20 hours of battery backup for the RAM with an automatic battery charger.
 9. Diagnostics: The DSC shall contain in its program a self-test procedure for checking the indication lights on the digital display and, by means of a indestructive memory, check the computer.
 10. Default Operating Procedure and Alarms:
 - a. Variables shall be identified as being reliable or unreliable. When a calculation is required to use a value (sensed or calculated) which is identified as being unreliable, the unreliable data value shall flash. The calculation shall use a default value programmed into the unit.
 - b. Alarms (fan that did not start, etc.) and deviation alarms (temperature off manual, etc.) shall light a red alarm light. A scan shall then identify alarm conditions and their identifier.
 11. Control Cabinets:
 - a. Enclose the DSC in a control cabinet. Construct cabinet such that it can be mounted and electrical terminations made during the construction phase of the project. Remove the DSC electronics and reinstall at a later phase, i.e., commissioning of the system.
 - b. The DSC cabinet shall be provided with a key lock. Multiple cabinets shall utilize one master key.
 - c. Control wiring and system communications shall be electrically terminated inside the DSC cabinet.
 12. Change-of-State Reporting: The system shall be able to detect changes in a controller's point status and report this change to the operator.
 13. Remote Communications: Construct the DSC cabinet shall include a general-purpose data modem for remote communications.

B. Application Specific Controllers

1. Controllers shall provide both standalone and networked direct digital control of items listed in input/output (I/O) Summary.
2. A dedicated controller shall be configured and provided for each primary HVAC system (chiller, boiler, including interlocked equipment)) and each Fan).
3. Each controller shall retain program, control algorithms, and setpoint information for at least 72 hours in the event of a power failure and shall return to normal operation upon stable restoration of normal line power.
4. Each controller shall report its communication status to the DSC. The DSC shall provide a system advisory upon communication failure and restoration.
5. For each primary HVAC system, provide means of indication of system performance and setpoints at the controller.
6. For each primary HVAC system, provide a means to adjust setpoints and start/stop equipment through the controller.
7. Provide a means to prevent unauthorized personnel from accessing setpoint adjustments and equipment control definitions.
8. The controller shall provide the functionality to download and upload configuration data, both locally at the controller and via the communications Network.

9. Control Cabinet

- a. Enclose the controller in a control cabinet. Construct cabinet such that it can be mounted and electrical terminations made during the construction phase of the project. Remove the controller electronics and reinstall at a later phase, i.e., commissioning of the system.
- b. Control wiring and system communications shall be electrically terminated inside the controller cabinet.

C. Trending

1. Trend and store all items listed in the I/O Summary charts.
2. Store for a period of seven calendar days.
3. Store data in a manner that allows custom queries and reports to be produced using industry-standard software tools.

2.9 REFRIGERANT MONITORING SYSTEM

- A. Provide refrigerant leak detection monitor system. Monitoring system shall support compliance with ANSI/ASHRAE Standards 15-2001 and 34-2001.
- B. The monitor shall be compound-specific for continuous monitor of HFO-513A.
- C. Sensors shall be connected by tubing to the monitor for location of sensor remote from the monitor.
- D. Alarm conditions shall be set for no greater than the refrigerant threshold limit value time weighted average (TLV-TWA). Detector shall have an accuracy within 1 ppm of TLV-TWA setpoint.
- E. Monitor shall have contacts for the following operations:
 1. Connection available for wiring to remote alarm.
 2. Connection available for wiring to remote ventilation equipment operation.
 3. Connection of alarm condition to building control system.
- F. Monitor shall have indication for leak alarm and for system fault conditions. Monitor shall have spill alarm.
- G. Monitor shall have addressable LED indication for:
 - PPM
 - Alarm Level PPM
 - Peak Level PPM
 - Spill Level PPM
- H. Detector shall be capable of operation in ambient temperatures from 0 to 45 degrees C and 0 to 90 percent (non-condensing) relative humidity.
- I. Monitors that require purge air shall have a filter on the purge intake and on the purge exhaust.

- J. Manufacturers: Eagle Creek, General Analysis Corp. (SAM), MSA, SenTech, Trane, Yokogawa,

PART 3 - EXECUTION

3.1 AUTOMATIC CONTROL SYSTEM

- A. Automatic control system subcontractor shall install and adjust entire control system and supervise initial operation with mechanics or subcontractors in his employ.
- B. Provide all field connections, relays, control transfer switches necessary for interlocking starters of (a) refrigeration equipment with pumps, refrigerant leak detection, and cooling tower starters; (b) supply fans with return, exhaust fan, coil circulator, boilers, pumps,
- C. Identify gages and controls. Note normal conditions with permanent markings.
- D. Control Diagrams
1. Submit in accordance with Section 23 05 00, "Basic Mechanical Materials and Methods," black line schematic wiring diagrams including graphic system representation, operating sequence and control description for entire system.
 2. Submit valve schedule.
 3. Upon completion of work, mount one "as built" set of diagrams in control panel associated with diagram.

3.2 CONTROLLERS

- A. Mount all controllers securely at accessible, vibration free locations.
- B. Housings for controls inside ducts shall be streamlined. Location subject to Engineer's approval.
- C. Field check calibration and adjustment of all controllers.
- D. Sensing Elements
1. Locate where responsive to representative temperatures.
 2. Provide elements with firm support and insulate from direct contact with coils or other heat conductors.
 3. Provide immersion bulbs with brass or copper separable wells with extension necks where required for insulation.
 4. Protect capillaries between element and controller where exposed to damage with flexible armor or conduit.
- E. Safety Controls
1. All safety controls and control interlocks shall be active with the motor start H-O-A switch in the "Hand," "Off," and "Automatic" positions.

3.3 VALVES

Comply with installation requirements in Section 23 20 00, "Building Services Piping."

3.4 CONTROL CABINETS (GRAPHIC USER INTERFACE)

- A. Provide at a location approved by the Engineer, adjacent to the equipment being controlled.
- B. Support panel from floor or building wall on steel legs or brackets allowing adequate access for servicing of controls.
- C. Provide primer and finish coat of black enamel on supports.
- D. Transmitters: Where distances between sensing element and panel mounted controller exceed recommended capillary length, provide signal transmission from sensor to controller.

3.5 ELECTRIC WIRING AND CONTROL

- A. Obtain control power from nearest power panel having 120 volts available. Provide branch circuit breaker in empty space in panel properly sized for load. Provide separate circuit breaker for each DDC cabinet.
- B. Control power may be derived from line side of a starter provided circuit is fused and all controls so energized are associated only with this starter and motor.
- C. Control transformer furnished as an integral part of a starter shall not be used as a power source for additional control.
- D. Starter disconnect or separate switch immediately adjacent to starter shall disconnect power from all line voltage or 120-volt control wiring entering starter.

3.6 CONTROL CENTER (GRAPHIC USER INTERFACE)

Locate where indicated on the drawings.

3.7 DIRECT DIGITAL CONTROL SYSTEM

Control of the primary equipment including items listed in the Input/Output (I/O) Summary Charts shall be performed by the Direct Digital Control System.

3.8 COORDINATION WITH TESTING, ADJUSTING, AND BALANCING SUBCONTRACTOR

- A. The Automatic Control System (ACS) Subcontractor shall put the system in the required mode of operation as requested by the Testing and Balancing (TAB) Subcontractor. All programming changes and reporting of data from the Building Automation System (BAS) needed to achieve proper performance shall be done by the ACS Subcontractor. The TAB Subcontractor shall be the lead Subcontractor in coordinating his work and the ACS Subcontractor's work. All work is by the TAB Subcontractor unless noted as being the responsibility of the ACS Subcontractor.

3.9 INPUT/OUTPUT (I/O) SUMMARY CHARTS

The control points on I/O Summary Charts are shown on the drawings.

3.10 REFRIGERANT MONITORING SYSTEM

- A. Mount where indicated with sensor near the floor as recommended by manufacturer. Mount monitor 60 inches above the floor.
- B. Provide tubing connection from monitor to sensor.
- C. Provide 120-volt connection to nearest emergency electric panel.
- D. Provide connection to remote alarm, existing boiler systems, and ventilation system operation.

END OF SECTION 23 09 23

SECTION 23 20 00 - BUILDING SERVICES PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Piping, fittings, joints, coatings, valves, strainers, supports, and flow measurement systems for Divisions 23.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Section 23 05 00 - Basic Mechanical Materials and Methods
- C. Section 23 05 48 - Mechanical Sound and Vibration Control
- D. Section 23 05 93 - Testing, Adjusting, and Balancing
- E. Section 23 07 00 - Mechanical Insulation
- F. Section 23 09 23 - HVAC Instrumentation and Controls
- G. Section 23 21 16 - Hydronic Piping Specialties
- H. Section 23 21 23 - Hydronic Pumps
- I. Section 23 64 16 - Liquid Water Chillers

1.3 QUALITY ASSURANCE

- A. Valves shall conform to ASME Boiler and Pressure Vessel Code Specifications where indicated or required by state or local code.
- B. All inline devices installed on the domestic service lines or building distribution system downstream of the water main and before end point devices and is in contact with the water intended for human ingestion shall comply with the Safe Drinking Water Act and National Sanitary Foundation (NSF) Standard 61, Annex G to provide lead-free water (not containing more than 0.25 percent lead).
 - 1. Inline devices include water meters, valves, check valves, strainers, meter stops, backflow preventers, fittings, etc.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00.
- B. Statement of piping and fitting material, and type of joint to be used for each piping system.

- C. Manufacturer's technical product data, installation instructions and description of accessories for each type to be used and system designation:

Coatings for Pipe
Valves
Strainers
Pipe Supports
Insulation Protection
Flow Measurement Systems
Thermometers and Test Wells

- D. NSF 61-G Certification of domestic water devices.

1.5 APPLICABLE PUBLICATIONS

The publications listed in this section form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

- A. Workmanship

1. Cut pipes accurately to measurements established at structure.
2. Install without springing or forcing.
3. Clear windows, doors, and other openings.
4. Permit expansion and contraction without misalignment or damage.
5. During construction, close openings in piping and equipment to keep out foreign matter and to prevent leakage.
6. Piping shall be concealed unless otherwise indicated.
7. Provide offsets required to avoid structural or other interference without extra cost to the government.

- B. Drainage

1. Grade to low points.
2. Provide hose end drain valves at bottom of risers, low points, and where indicated.

- C. Access: All valves, unions, flanges, and flow measurement devices shall be installed in accessible locations.

PART 2 - PRODUCTS

2.1 FITTINGS AND ACCESSORIES

- A. Welding Branch Fittings: Welding tees, Bonney Weldolets, or Thredolets, Allied Piping Products Type 1 fittings.
- B. Reducers: Reducing fittings, eccentric type where required to prevent pocketing of air and water.

C. Unions, Flanges, Mechanical Couplings, and Gaskets

1. Suitable for intended duty and rated for not less than system test pressure.
2. Dielectric (insulating) type in water piping systems, suitable for intended service.

2.2 PIPE, FITTINGS AND JOINTS

A. Pipe

TYPE	REFERENCE
E	Black Steel Pipe: ASTM A53 Grade B, ERW or seamless; or ASTM A106 Grade B seamless. Sizes through 10 inches, standard weight, 12 inches and larger 3/8-inch.
F	Galvanized Steel Pipe: Same reference as E.
L	Seamless Copper Water Tube: ASTM B88, Type "L" hard temper.

B. Fittings

TYPE	REFERENCE
BB	Wrought Copper Solder Joint Fittings: ANSI/ASME B16.22.
DD	Black Malleable Iron Screwed Fittings: 150 psi ANSI/ASME B16.3.
EE	Galvanized Malleable Iron Screwed Fittings: 150 psi, ANSI/ASME B16.3.
MM	Steel Butt-Welding Fittings: ANSI/ASME B16.9.
NN	Galvanized Steel Butt-Welding Fittings: ANSI/ASME B16.9.
XX	Factory Grooved End Fittings: ASTM A395 and A536 ductile iron; ASTM A234 forged steel; or factory-fabricated from carbon steel pipe conforming to ASTM A53. Anvil or Victaulic. Tees equal to Victaulic Style 20, 25, 27, or 29 or approved equal.
YY	"XX" Galvanized.

C. Joints

TYPE	REFERENCE
1	Threaded-American Standard for Pipe Threads: ANSI B1.20.
2	Welded-Engineering Standards of the Mechanical Contractor Association of America, Inc., Part VII, Standard Procedure Specifications Nos. 1 and 2.
7	Soldered: ASTM B32; Tin-antimony, 95-5, tin silver 96-4, or tin silver 94-6.
9	Brazed-Silver Alloy Brazing equal to Sil-Fos and Easy-Flow by Handy and Harman.
23	Mechanical Couplings: Anvil or Victaulic equal to Victaulic Style 07 or S107 zero-flex rigid couplings or Victaulic Style 77 flexible couplings with gaskets suitable for minus 30 to 230 degrees F continuous temperature. Victaulic Style 77 flex coupling or approved equal shall be limited to connections at equipment and where indicated on drawings.

2.3 COATING AND WRAPPING

Type D: Inorganic zinc-lead silicate equivalent to Carboline Carbozinc II.

2.4 VALVES

- A. Manufacturer's Tests: Each valve shall be given shell and seat tests by the manufacturer and shall carry a permanently affixed indication that tests have been successfully completed.
- B. ASME Boiler Code Compliance: Provide valves, which conform to ASME Boiler Code Specifications, where indicated, or where required by state or local code.
- C. Combination Balancing and Shutoff Valve
 - 1. HVAC Systems
 - a. Type A:
 - (1) Ball-valve type equal to Taco Accu-Flo.
 - (2) Maximum open adjustable stop.
 - (3) Dial or gage indicator for balanced position.
 - (4) Leak proof pressure connections with caps.
 - (5) Manufacturers: Armstrong, Bell & Gossett, Taco, Flow Design Accusetter, Griswold.
- D. Butterfly Valves
 - 1. Material and Construction: Cast iron full lug wafer body for flanged connection with alignment boltholes or guides. Resilient, mechanically retained, field replaceable seat of Nordel, EPDM or approved elastomer, suitable for continuous duty at 250 degrees F. Stainless steel disc. Stainless steel shaft with teflon self-lubricating bearings, "O" ring or chevron stem seals for continuous duty at 250 degrees F. Two-inch extension neck on valves for insulating piping. Thrust bearings or vented shaft end to support or neutralize hydraulic or external axial shaft loads.
 - 2. Pressure Ratings: 150-psi body; bubble tight shut off for 150-psi differential in either direction. Bubble-tight dead-end service. Factory test each valve for operation, leakage, and pressure in accordance with AWWA Standard C504.
 - 3. Actuator: For valves under 8 inches, lever with locking trigger with notched quadrant. For valves 8 inches and above, enclosed, self-locking worm gear or worm screw with hand wheel. Both types equipped with adjustable maximum opening travel stops.
 - 4. Installation: Use welding neck or socket type companion flanges. Valves may be connected directly to flanges used as unions to permit equipment, control or check valve removal if equipped with tapped lugs or integral double flanges and secured so that valve remains in service when equipment is removed.
 - 5. Manufacturers: Stockham, Fisher, NIBCO, Milwaukee, Hammond, Jamesbury, Centerline, Grinnell, Keystone, Continental, Bray, DeZurik, TRW Mission, Crane-Monark, Demco; Victaulic Vic-300 in compatible piping systems.
- E. Drain Valves: Hose end ball valve with cap and chain equal to NIBCO Fig. T-585-70-HC series ball with American Standard Garden Hose type threads. Drain valves on potable water systems shall include a vacuum breaker hose connection.
- F. Silent Check Valves: Equivalent to Mueller Steam Company figure numbers as follows:
 - 1. Two-inch and Larger:

- a. Figure 105M, globe type, flanged. Body: Cast iron, ASTM QA126, Class B or carbon steel ASTM A216, Class WCB.
 2. One-half to 1-1/2-inch: Figure 303, threaded. Body: Bronze, ASTM B62.
 3. Seat Disc, Spring:
 - a. Stainless steel springs and guides with stainless steel or bronze ASTM B62 disc and seat.
 4. Manufacturers: Milwaukee, NIBCO, Williams-Hager, APCO Valve and Primer Co., Hammond, Mueller Steam, Miller Valve Co.; Steamflo. Victaulic and Grinnel in compatible piping systems.
- G. Globe and Check Valves
1. Globe valves designed for repacking under pressure when fully opened, and equipped with packing suitable for the intended service. When the valve is fully opened, the back seat shall protect the packing and the stem threads from the fluid. Each gate and globe valve shall have a gland follower.
 2. Bronze valves with the basic saturated steam rating of 125 psi or 150 psi shall have pressure containing parts of a material having at least the physical properties of ASTM Specification B-62. Metallic seated bronze check valves with a basic steam rating of 200 or 300 psi having pressure containing parts of material conforming to ASTM B-61, for temperatures to 550 degrees F.
 3. Handwheels of ASTM A47 malleable iron or ASTM A126, Class A or B iron.
 4. Manufacturers: Unless otherwise indicated, Crane, Grinnell, Hammond, Kennedy, Milwaukee, NIBCO, Powell or Stockham equal to NIBCO or other listed manufacturer figure numbers as noted in Schedule of Services.
- H. Ball Valves
1. Ball valves shall have stem extension to place handle outside the insulation when valve is to be installed in insulated piping.
 2. Type A: Bronze or brass body, stainless steel ball and stem, reinforced Teflon seats and seals, full port size, threaded or solder end as required scheduled through 2-inch size and acceptable for 2-1/2-inch size if valve is full port. Valve shall be three-piece or shall have removable cartridge to permit complete access removal, and replacement of components without removal of the valve from the piping system and without disturbing the piping system. NIBCO 595-Y-66.
 3. Type C: Stainless steel body, ball and stem, reinforced teflon seats and seals, reduced port, flanged end. NIBCO F510-S6-R-66.
 4. Type D: Lead-free silicon brass alloy body, stem, and ball, Virgin PTFE seats, EPDM seals, full port size, threaded or soldered end as required through 2-inch size and acceptable for 2-1/2-inch size if valve is full port. Valve shall be two-piece and be NSF 61-G listed. NIBCO 685-80-LF.
 5. Manufacturers: Unless otherwise indicated, Apollo, Crane, Dynaquip, Fairbanks, Hammond, ITT Grinnell, Jamesbury, Milwaukee, NIBCO, Powell, Watts, for the types listed in Schedule of Services.
- I. Schedule of Services: Unless otherwise indicated, valves are for aboveground service. Size range indicated is size of pipe where valves are required. Valves shall be pipe size or larger.

DOMESTIC HOT AND COLD WATER				
TYPE	SIZE RANGE	SPECIFIC REQUIREMENTS	STYLE	FIGURE NO.
Ball	2-inch and Smaller	NSF 61-G Listed	-	Type D

CONDENSER AND CHILLED WATER (125 PSIG AND LESS)				
TYPE	SIZE RANGE	SPECIFIC REQUIREMENTS	STYLE	FIGURE NO.
Butterfly	4-inch and Larger	-	-	See Specifications
Ball	2-1/2 & 3-inch	Use 3-inch Valve for Both Pipe Sizes	-	Type C
Ball	2-inch and Smaller	-	-	Type A
Check	2-1/2-12-inch	-	IBBM, FLG	F-918-B
Check	2-inch and Smaller	-	Screwed End Soldered End	T-433-B S-433-B

J. Automatic Water Flow Control Valves

1. Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control. Provide standard pressure taps and four sets of capacity charts. Valve size shall be as indicated on the drawings and be one of the following designs:
 - a. Gray iron (ASTM A126) or brass body rated 175 psig at 200 degrees F, with stainless steel piston and spring that is easily removable for inspection or replacement.
 - b. Brass or ferrous body designed for 300 psig service at 250 degrees F, with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
 - c. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure/temperature ports shall be acceptable.
 - d. Valve shall be capable of passing a 1-inch solid.
 - e. Valve shall be permanently marked to show direction of flow, shall have a body tag to indicate model number and flow rate.
 - f. Provide certified independent laboratory tests verifying accuracy of performance.
 - g. Warranted by the manufacturer for five years from date of sale.
 - h. Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.
2. Manufacturer: Griswold.

2.5 STRAINERS

- A. Size and Screen Openings: Provide full line size strainers irrespective of equipment connection size. Provide free area of screen not less than 2-1/2 times inlet pipe area.
- B. Multiple Basket Type: Zurn Series 510 Sinlex with closed bottom stainless steel baskets.
- C. Single Basket Type: Mueller No. 165 with closed bottom stainless steel basket.

- D. "Y" Type: For 2-inch and smaller Mueller No. 11 with open bottom stainless steel screen. For 2-1/2-inch or larger, Mueller No. 758 with open bottom stainless steel screen.
- E. Duplex Type for Fuel Oil: Kraissl Class 72 integral series duplex series with closed bottom stainless steel screen.
- F. Perforations: Diameter of perforations, water service 4-inch and smaller - 0.057-inch, 5-inch and larger - 0.125-inch (double diameter for condenser water service).
- G. Magnet: Bolt Alnico channel magnets to strainer screens at suction of pumps except fuel oil systems. Provide magnets of sufficient strength and spacing to attract all ferrous particles entering strainer.
- H. Drain: Pipe plug or factory-installed hose-end drain valve as indicated on drawings.
- I. Galvanizing: Strainer bodies for galvanized lines shall be galvanized.
- J. Interior lining shall comply with FDA-approved, epoxy coating or NSF 61-G compliant on domestic water lines.
- K. Manufacturers:
 - 1. Multiple Basket: Zurn, McAlear, Mueller, Steamflo, Tate Andale.
 - 2. Single Basket and "Y" Type: Boylston, McAlear, Mueller, Spence, Tate Andale, Sarco, Nicholson, Metraflex, Keckley.
 - 3. Duplex Type for Fuel Oil: Kraissl, Haywood, Tate Andale, Preferred Utilities, Steamflo.
- L. Optional Suction Diffuser: Cast iron angle body with straightening vanes, stainless steel combination diffuser strainer with 3/16-inch diameter openings; removable, bronze start-up strainer; adjustable support foot to relieve piping strains from pump suction. Equip units with removable magnets of sufficient strength and spacing to attract ferrous particles entering the strainer.

Manufacturers: Taco, Bell and Gosset; Victaulic, Grinnell in compatible piping systems.

2.6 PIPE SUPPORTS

- A. General: Supports shall be plastic coated for plastic pipe, copper plated for copper tubing and brass pipe, galvanized for uninsulated galvanized steel pipe, and black steel for other metallic piping. Outdoor supports shall be copper plated for copper tubing and brass piping, and galvanized for all other piping.
- B. Horizontal Piping
 - 1. Clevis Hangers: Adjustable wrought steel clevis hangers.
 - 2. Roll Hangers: Adjustable steel yoke roll hangers for chilled water piping larger than 2-1/2-inch diameter.
 - 3. Under Supports:
 - a. Where no provision for expansion and contraction is required:
 - (1) Floor Mounted: Adjustable cast iron saddle with floor flanges secured to floor and pipe nipple of suitable length.

- (2) Trapeze or Metal Frame Mounted: Inverted U bolts with saddle supports for insulated pipe.
 - (3) Wall Mounted: Steel J hooks for pipes 3-inch and smaller; welded steel brackets for larger pipes with hanger or support same as for trapeze.
- b. Where provision for expansion and contraction is required provide adjustable pipe roller and base secured to support. For floor mounting provide concrete pier under base; for wall mounting provide welded steel bracket.
4. Metal Frame Supports:
- a. Provide as required, vertical and horizontal 12 gage galvanized steel channels and fittings bolted together to form a multiple pipe rack secured to the building structure with post bases and brackets. Equal to Grinnell Power-Struct, ASTM A-446, Grade A, hot dipped zinc coated steel with safety end enclosures.
 - b. Manufacturers: B-Line, Steel City, Unistrut, Grinnell.
5. Lateral Movement: Provide dual movement type rollers where undersupports are required and where expansion and contraction will cause lateral movement.
- C. Vertical Piping
- 1. Steel extension pipe clamps for piping not subject to vertical movement by expansion or contraction.
 - 2. Variable spring supports for piping subject to vertical movement by expansion or contraction.
 - 3. Base fitting set on concrete, brick pier or pipe stand where necessary at bottom of piping risers.
- D. Insulation Protection
- 1. Saddle: 18 gage galvanized sheet metal.
 - 2. Roller Saddle: Curved steel with protecting lugs or turned up edges.
 - 3. Thermal Shield: 360 degree insert of waterproofed calcium silicate insulation with 100 psi compressive strength encased in galvanized steel jacket equivalent to Pipe Shields, Inc. Model A2000 (CS-CW Series) for chilled water and Model A1000 (CS) for other insulated lines. Use Model A4000 (CSX-CW) and Model A3000 (CSX) wherever pipe hanger span exceeds 10 feet and for pipe roller applications. Insert shall be same thickness as adjoining pipe insulation. Shield length and minimum sheet metal gages as indicated. Insulation insert shall extend 1-inch beyond sheet metal shield on chilled water piping. Where pipe hanger spacing exceeds 10 feet and where pipe rollers are used, provide double layer shield on bearing surface.
- Manufacturers: B-Line, Pipe Shields, Inc., Value Engineered Products.

PIPE SIZE IN INCHES	SHIELD LENGTH IN INCHES	MINIMUM GAGE
1/2 – 1-1/2	4	26
2 – 6	6	20
8 – 10	9	16

2.7 PIPE PEDESTALS

- A. Furnish pipe mounting pedestals equal to Roof Products and System Corp., Model ER-4A, where indicated on the drawings. The pipe mounting pedestal shall include equipment rail, sized for the number of pipes and specified in this section, as associated galvanized steel slide channel attached to "U" shaped mounting brackets and secured to side of equipment rails with lag bolts supplied. The pipe roller assembly shall have galvanized 18-inch long continuous threaded rod to give 12-inch vertical adjustment, galvanized removable pipe retainer bracket for 12-inch horizontal adjustment. All pipe mounting pedestals shall be factory assembled.
- B. Manufacturers: Pate, Roof Products and Systems Corporation.

2.8 PIPE PORTALS

- A. Furnish pipe portals equal to Roof Products and Systems Corporation, where indicated on the drawings. The pipe portal shall include an 18 gage galvanized steel roof curb, Model RC-4A, with integral baseplate, continuously welded corner seams, factory-installed wood nailer and 1-1/2-inch, 3 pound density rigid fiberglass insulation.
- B. The pipe portal shall be provided with a laminated acrylic-coated ABS plastic curb cover with prepunched holes and molded sealing ring on an 8-inch collared opening, and an EPDM compression molded cap with stainless steel snaplock clamps.
- C. Curb covers shall be resistant to ozone and ultraviolet rays and shall have a serviceable temperature range of minus 40 to 350 degrees F. The protective rubber caps shall have a serviceable temperature range of minus 60 to 250 degrees F and shall be resistant to ozone and ultraviolet rays. The conical shaped steps of the nipple shall provide a weatherproof seal around the penetration. The stainless steel snaplock clamps shall provide added protection to guarantee the seal.
- D. Manufacturers: Pate, Roof Products and Systems Corporation.

2.9 FLOW MEASUREMENT SYSTEMS

- A. Type A
 - 1. Measuring Device: Nozzle venturi or impact tube type. Select to read specified flow between 30 and 80 percent of meter range. Construct venturi with smooth brass, cast or fabricated steel throats. Type 316 stainless steel impact tubes. Identify manufacturer's name and address; serial number of the meter to which it is connected; the name, number, or location of the equipment served; the specified flow rate; the multiplier (including unity where applicable); the applied meter reading; pipe size conversion factor or chart die stamped on device or stainless steel chain attached metal tag. Quick disconnect valves. Maximum non-recoverable loss: 1-foot w.g.
 - 2. Portable Meter: Pressure differential type with double bellows diaphragm, 0 to 50 or 100-inch w.g. range; horizontal or vertical reading position, equalizing and bleed valves; or rotameter type with direct connection, shutoff valve, protected quartz tube, direct reading scale or indirect-reading scale with chart or power of 10 conversion. Furnish charts, if required, in clear plastic sleeves in ring binder. Furnish additional meters if more than one

required for specified flow range of devices and permanently identify on device or meter proper meter for each measuring point.

3. Accessories
 - a. Remote reading meters with two 10-foot long flexible hoses.
 - b. Drain and purge attachment and other items necessary for proper cleaning of measuring device.
 - c. Flushing attachment for rotameters.
 - d. Carrying case for each meter and its accessories.

4. Manufacturers:
 - a. Nozzle Type: Aeroquip-Barco, Gerand, Barton-Badger, Fischer & Porter, Preso, Flow Design, Inc.
 - b. Impact Tube Type: Barton-Badger, Dietrich Standard-Annubar, Fischer & Porter, Taco, Preso.

2.10 THERMOMETERS AND TEST WELLS

A. Types

1. Direct Mounting: 5-inch dial, externally calibrated, standard industrial bimetal, with stainless steel stems and cases equal to Weston Models 4503 and 4513. Stem length - minimum, 1/2 depth of pipe; maximum, 24 inches.
2. Where indicating points cannot be conveniently read or temperature correctly sensed, provide mercury filled protected capillary tube for remote mounting.

B. Ranges

1. For Media Temperatures not Exceeding 100 degrees F: 25 to 125 degrees F.
2. For Media Temperatures above 100 degrees F, but not Exceeding 220 degrees F: 30 to 240 degrees F.

C. Accessories: Provide with separable brass wells with insulation extension on insulated pipe.

D. Manufacturers: Ashcroft, Marsh, Marshalltown, Moeller, Taylor, Tel-Tru, Terrice, U.S. Gage, Weiss, Weksler, Weston, Winters.

E. Test Wells: Provide brass thermometer wells with screw cap and chain.

2.11 PRESSURE GAGES AND TEST CONNECTIONS

A. Type: General purpose bronze bourdon tube, bronze bushed movement mounted on socket independent of case, 1 percent minimum accuracy at mid range, 4-1/2-inch face equal to Ashcroft Catalog No. P2070A.

B. Ranges: Approximately twice the maximum operating pressure. Provide compound gages wherever negative pressures can occur.

- C. Accessories: Provide gages with Trerice No. 735 or 740 valve suitable for intended pressure, temperature and service and, for steam, brass siphon tubes. For pump and compressor suction and discharge, provide porous core snubbers.
- D. Manufacturers: Ashcroft, Marsh, Marshalltown, Moeller, Taylor, Tel-Tru, Trerice, U.S. Gage, Weiss, Weksler, Weston, Winters.
- E. Test Connections: Provide with Trerice No. 735 or 740 gage valves suitable for intended pressure.

PART 3 - EXECUTION

3.1 FITTINGS AND ACCESSORIES

- A. Welding: Make changes in direction and size with welding fittings. Use welded branch fittings in joining a branch to a main. Finish exposed galvanized welds with Galv-Weld.
- B. Reducers: Use reducing fittings to make changes in pipe sizes.
- C. Unions, Flanges, Mechanical Couplings, and Gaskets
 - 1. Install at each piece of equipment, in bypasses, and long piping runs to permit disassembly for alteration and repairs.
 - 2. Equipment Connections: Provide piping connections which conform to indicated sizes, details, reviewed shop drawings, and printed installation instructions furnished by manufacturer.
 - 3. Contractor shall install tongue and recess mechanical couplings with a torque wrench in accordance with manufacturer's recommendations. Use of an impact wrench is not permitted on tongue and recess mechanical couplings.
- D. Threads: Remove burrs and ream to full inside diameter.

3.2 PIPE, FITTINGS AND JOINTS

- A. Schedule

SYSTEM	PIPE	FITTINGS	JOINTS
Domestic Cold Water			
1. Aboveground: 2-1/2-inch and larger	L	BB	9
	F	EE	1
	F	YY	23
2. Aboveground: 2-inch and smaller	L	BB	9
Condenser Water			
1. Aboveground, within building	E	MM	2
	E	XX	23
2. Aboveground, exposed to weather * With Type D Coating	E*	XX	23
	F	NN	2
	F	YY	23
Chilled Water			

SYSTEM	PIPE	FITTINGS	JOINTS
1. 2-1/2-inch and larger	E	MM	2
	E	XX	23
2. 2-inch and smaller	E	DD	1
	L	BB	7

3.3 COATING AND WRAPPING

A. Type D

1. Sandblast piping in accordance with Steel Structures Painting Council SSPC-SP-5-52T.
2. Immediately after sand blasting, coat piping with 2 to 3 mil thickness of inorganic zinc.

3.4 VALVES

- A. Adjust for smooth and easy operation.
- B. Install in locations where valve can easily be adjusted.
- C. Install valves full size of pipe before reducing size to make connection to equipment and controls.
- D. Remove excess solder and other foreign matter from valve interior after installation before operating valve.
- E. Provide chainwheel operators for valves in equipment rooms mounted greater than 7 feet above floor level. Extend chain to 7 feet 0 inches above floor level.
- F. Cut Off or Stop Service: Ball, as specified, except butterfly valves for condenser and chilled water service 4 inch and larger. Series 100 DeZurik as specified under "Non-lubricated Plug Valves" may be used in lieu of ball or butterfly valves.
- G. Throttling or Control Valve Bypass: Globe or non-lubricated plug valves.
- H. Balancing Valves:
 1. Three-inch and Smaller: Combination balancing and shutoff valve.
 2. Four inches and larger. Non lubricated plug valve.
- I. Silent Check Valves: Install in pump discharge piping where check valves are indicated.
- J. Set field adjustable flow set point of balancing valves.

3.5 STRAINERS

- A. Water
 1. 2-inch and smaller - "Y" type.
 2. 2-1/2 to 16 inches, single basket type.
- B. Support strainers at pumps independent of piping system.

- C. Suction diffuser type may be used for chilled water, systems where pipe size is 8 inches and smaller.

3.6 PIPE SUPPORTS

A. Preparation and Application

1. Provide supports to maintain required slope and alignment.
2. Secure hangers to rods with double nuts.
3. Make allowance for expansion and contraction.
4. Do not support pipes from ducts or other pipes.
5. Use trapeze hangers for parallel runs of pipe with same slope.
6. Provide bracing to prevent lateral motion of horizontal or vertical piping.
7. Provide supports at or near changes in direction.
8. Do not pierce ducts with hanger rods.
9. Provide strength and rigidity suitable for loads imposed.
10. Support piping so there is no strain on the connection to pumps and other equipment.
11. Support piping using mechanical couplings in accordance with manufacturer's instructions and recommendations.

B. Horizontal Piping

1. Adjustment: Provide vertical adjustment of supports for horizontal piping after installation.
2. Maximum Support Spacing:
 - a. Steel Lines: 1-1/2-inch and smaller, 6 feet; 2-inch and larger, 10 feet.
 - b. Copper Lines: 1-1/2-inch and smaller, 5 feet; 2-inch and larger, 8 feet.
3. Metal Frame Supports: Space frames in accordance with smallest pipe requirements and design for a maximum deflection of 1/360 of the span.

C. Vertical Piping

1. Support vertical lines at locations indicated.
2. Where supports are necessary at bottom of risers, provide a base fitting set on either concrete or brick pier or a pipe stand. In lieu of using a base fitting, a hanger at bottom horizontal connection may be used. Locate hanger as close to riser as possible, but permitting sufficient free offset where allowance for expansion and contraction is necessary.

D. Insulation Protection

1. For chilled water piping, provide saddle for piping 4-inch and smaller. Provide thermal shield for piping larger than 4-inch. Thermal shields for pipes 4-inch and smaller is optional.
 - a. Saddle: For "Chilled Water Piping," (refer to Section 23 07 00, "Mechanical Insulation" for extent) provide hangers outside of covering. Between hanger and covering, provide sheet metal saddle formed to fit bottom half of the insulation. Minimum side dimension of saddle equal to one half the insulation circumference.
 - b. Thermal Shield: Provide 3-inch wide vapor barrier tape or band over butt joints. Where vapor barrier is required, apply a wet coat of vapor barrier lap cement on butt

joints before applying tape or band. Coordinate with Section 23 07 00, "Mechanical Insulation."

2. Roller Saddle: Provide where insulated piping other than chilled water lines are supported on rollers. Weld lugs to pipe.

3.7 PIPE PEDESTALS

Install in accordance with manufacturer's instructions and recommendations.

3.8 PIPE PORTALS

Install in accordance with manufacturer's instructions and recommendations.

3.9 FLOW MEASUREMENT SYSTEMS

- A. Provide Type A system, including one portable meter, to measure flow through chilled and condenser water coil banks and other locations as indicated on drawings for application of 4-inch size and larger.
- B. Locate Type A measuring devices to be used with direct connecting rotameter with adequate front and top clearance in front and above for insertion and proper readability.

3.10 THERMOMETERS AND TEST WELLS

- A. Install thermometers at temperature control points (except individual room thermostats); water entering and leaving condensers, chillers, and converters, and elsewhere as indicated.
- B. Install test wells where indicated on the drawings, located above horizontal position in pipe with 12-inch minimum clearance above well.

3.11 PRESSURE GAGES AND TEST CONNECTIONS

- A. Install pressure gages at pressure control points, pump suction and discharge and elsewhere as indicated.
- B. Install test connections suitable for intended pressure in piping entering and leaving chillers and condensers and where indicated for testing.

3.12 PIPE TESTING

- A. Preparation and Application
 1. Test piping to prove tightness.
 2. Test concealed piping before enclosing.
 3. Replace and re-test pipe or fittings broken or damaged under test.
 4. Remove or protect from damage items not designed to withstand testing pressure; e.g., control devices, air vents, boilers, and thermostatic trap elements.

5. Advise COR prior to tests.

B. Pressure Testing

1. Test pressures shall be 1-1/2 times the system working pressures and a minimum of 100-psi, unless otherwise indicated.
2. Test water piping hydrostatically protecting traps, seals, etc. from excess pressure.
3. Valves shall be open, but not backseated for packing check. However, it is permissible to test against a closed valve if the test pressure does not exceed the valve pressure rating at test temperature.
4. Blind flanges, or the equivalent, shall be used instead of valves for dead-end shutoff.
5. Inspect each joint for leakage while under test.
6. Apply soapsuds to joints under air pressure test.
7. Maintain pressure tests for a minimum of four hours.
8. Maintain applicable safety methods while performing tests. These methods shall include but shall not be limited to applying pressure at increments of 25 psi, providing sufficient time to allow the piping to equalize strains, until specified test pressure is attained. The piping system shall be examined only when the pressure in it is not increasing.

END OF SECTION 23 20 00

SECTION 23 21 16 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Fluid handling equipment and associated accessories, piping, and air control.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Section 23 05 00 - Basic Mechanical Materials and Methods
- C. Section 23 05 93 - Testing, Adjusting, and Balancing
- D. Section 23 07 00 - Mechanical Insulation
- E. Section 23 09 23 - HVAC Instrumentation and Controls
- F. Section 23 20 00 - Building Services Piping
- G. Section 23 21 23 - Hydronic Pumps
- H. Section 23 64 16 - Liquid Water Chillers

1.3 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VII, Division 1.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00.
- B. Manufacturer's technical product data, including installation instructions, performance data, accessories, supports, fittings, finishes, construction details, and dimensions of components:

Air Vents
Strainers

- C. Operation and Maintenance Data: Include in emergency, operation, and maintenance manuals.
- D. Welding certificates.

1.5 APPLICABLE PUBLICATIONS

The publications form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

- A. Provide all material and equipment specified in this section with performance requirements as stated herein or on the drawings.
- B. Except where specified, equipment and system capacities and performance requirements are scheduled on the drawings.

PART 2 PRODUCTS

2.1 GENERAL

Refer to drawings for tank sizes, piping arrangement and pressure settings.

2.2 EXPANSION TANKS

- A. Pressurized Expansion Tank: Provide bladder type tank as manufactured by Bell & Gossett, Taco, or Amtrol. Tank shall include system connection, bladder access/replacement flanges, drain connection, lifting ring, air charging valve and floor mounting skirt for vertical installation. Tank shall be suitable for vertical and horizontal installation with lifting rings and drain connection for both installation positions. Tank shall be constructed and labeled for compliance with ASME Boiler and Pressure Vessel Code suitable for 125 psig working pressure and 375 degrees F maximum operating temperature.
 - 1. Bladder shall be replaceable heavy-duty butyl rubber securely sealed to separate air charge from system water to maintain required expansion capacity.
 - 2. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

2.3 AIR VENTS

- A. Manual Air Vents
 - 1. Body: Bronze.

2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: 1/2-inch.
5. Discharge Connection: 1/8-inch.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature 225 degrees F.

B. Automatic Air Vents

1. Taco No. 426 or approved equal.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: 1/2-inch.
6. Discharge Connection: 1/4-inch.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 degrees F.

C. High Capacity Air Vent: Amtrol Model 720, Taco No. 418 or approved equal.

2.4 STRAINERS

A. Size and Screen Openings: Provide full line size strainers irrespective of equipment connection size. Provide free area of screen not less than 2-1/2 times inlet pipe area.

B. Single Basket Type: Mueller No. 165 with closed bottom stainless steel basket.

1. Body: ASTM A126, Class B cast iron with bottom drain connection.

C. Multiple Basket Type: Eaton 510 with closed bottom stainless steel baskets.

1. Body: Iron with bolted cover and bottom drain connection.
2. Flanged ends.

D. "Y" Type:

1. For 2-inch and smaller Mueller No. 11 M with open bottom stainless steel screen rated for 125 psig.
 - a. Body: ASTM A126, Class B, cast iron with bottom drain connection.
 - b. Threaded ends.
2. For 2-1/2-inch or larger, Mueller No. 58 with open bottom stainless steel screen rated for 125 psig.
 - a. Body: ASTM A126, Class B, cast iron with bolted cover with drain connection.
 - b. Flanged ends.

E. Perforations: Diameter of perforations, water service 4-inch and smaller - 0.057-inch, 5-inch and larger - 0.125-inch (double diameter for condenser water service).

- F. Magnet: Bolt Alnico channel magnets to strainer screens at suction of pumps except fuel oil systems. Provide magnets of sufficient strength and spacing to attract all ferrous particles entering strainer.
- G. Drain: Pipe plug or factory-installed hose-end drain valve as indicated on drawings.
- H. Galvanizing: Strainer bodies for galvanized lines shall be galvanized.
- I. Manufacturers:

Single Basket and "Y" Type: Boylston, Keckley, McAlear, Metraflex, Mueller, Nicholson, Sarco, Spence, Tate Andale.
Multiple Basket: Eaton, McAlear, Mueller, Steamflo, Tate Andale.
- J. Optional Suction Diffuser: Cast iron angle body with straightening vanes, stainless steel combination diffuser strainer with 3/16-inch diameter openings; removable, bronze start-up strainer; adjustable support foot to relieve piping strains from pump suction. Equip units with removable magnets of sufficient strength and spacing to attract ferrous particles entering the strainer.

Manufacturers: Taco, Bell and Gosset; Victaulic, Grinnell in compatible piping systems.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install safety valves as required by ASME Boiler and Pressure Vessel Code. Install drip pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on drawings. Comply with ASME Boiler and Pressure Vessel Code; Section VIII, Division 1, for installation requirements.
- B. Install pressure-reducing valves at makeup water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install expansion tanks on the floor as indicated. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system project requirements.
- B. Install automatic air vents at tops of risers and high points of system except where manual air vents are indicated. Pipe overflow to nearest floor drain, service sink or as indicated.
- C. Strainers
 - 1. Water: 2-inch and smaller - "Y" type
2-1/2 to 16 inches - single basket type
18 inches and larger - multiple basket type
 - 2. Support strainers at pumps independent of piping system.
 - 3. Suction diffuser type may be used for chilled water systems where pipe size is 8 inches and smaller.

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Bid Set

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END OF SECTION 23 21 16

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Fluid handling equipment and associated integral supports, accessories, piping, motors and integral controls.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Section 23 05 00 - Basic Mechanical Materials and Methods
- C. Section 23 05 48 - Mechanical Sound and Vibration Controls
- D. Section 23 05 93 - Testing, Adjusting, and Balancing
- E. Section 23 07 00 - Mechanical Insulation
- F. Section 23 09 23 - HVAC Instrumentation and Controls
- G. Section 23 20 00 - Building Services Piping
- H. Section 23 21 16 - Hydronic Piping Specialties
- I. Section 23 64 16 - Liquid Water Chillers
- J. Division 26 - Electrical

1.3 QUALITY ASSURANCE

- A. Equipment specified shall meet all requirements of ASHRAE Standard 90.1, Section 6.
- B. Provide UL label on electric powered equipment or certification that equipment has been tested by a testing agency approved by local authority and is equivalent in safety to UL labeled equipment.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00.
- B. Manufacturer's technical product data, including installation instructions, performance data, accessories, supports, fittings, finishes, construction details, and dimensions of pumps.
- C. Certified performance curves indicating operating points.

- D. Final impeller dimensions.
- E. Operation and Maintenance Data for pumps including emergency, operation and maintenance manuals.

1.5 APPLICABLE PUBLICATIONS

The publications form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

- A. Provide all material and equipment specified in this section with performance requirements as stated herein or on the drawings.
- B. Except where specified, equipment and system capacities and performance requirements are scheduled on the drawings.
- C. Furnish one additional mechanical seal for each pump in package with protective cover for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Impeller size for specified duty shall not exceed 85 percent of volute cutwater diameter.
- B. Maximum cataloged impeller size shall be rated to produce not less than 110 percent of specified head at specified flow.
- C. Required net positive suction head shall not exceed scheduled limit.
- D. Brake horsepower at specified conditions shall not exceed 78 percent of motor nameplate horsepower times service factor. Horsepower at any flow with selected impeller shall not exceed motor nameplate horsepower times service factor.
- E. Capacities as scheduled on drawings.
- F. Submit performance curves demonstrating compliance with above requirements.
- G. Pump construction (unless otherwise indicated for specific pumps or types).
 - 1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute and flanged connections.
 - 2. Impeller: ASTM B 584, cast bronze or stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
 - 3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
 - 4. Trim: Bronze or stainless steel.

5. Mechanical Seal: Tungsten carbide seal and Buna-N bellows and gasket.
6. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
7. Working Pressure: 125 psig.
8. Additionally for Types A Pumps: Wear rings, bronze or stainless steel shaft sleeves for mechanical seal pumps. Sleeves shall shroud shaft in contact with fluid and extend to outboard side of seals. For pumps with external flushing of seals, provide flushing connection to mechanical seal housings directly over seal faces.
 - a. For pumps without internal flushing of seals, provide John Crane Kynar Abrasive Separator for each mechanical seal on all Type A pumps.

H. Shaft Coupling:

1. For Type A Pumps: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor, if available as an option. Provide EPDM coupling sleeve for variable-speed applications.

I. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

J. Mounting Frame for Type A Pumps: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

K. Motor: Single speed, secured to mounting frame, with adjustable alignment.

8. 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.

L. Provide drain rim base with deflector plates beneath outboard surfaces for pumps handling fluids 60 degrees F or lower to collect condensation from cold surfaces. Equip with drain connection.

2.2 TYPE A - SEPARATELY COUPLED, BASE-MOUNTED, END SUCTION CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Equivalent to Taco FI.

B. Motor shall be secured to mounting frame with adjustable alignment.

C. Manufacturers: Allis-Chalmers, Amtrol, Armstrong, Aurora, Bell and Gossett, Buffalo, Goulds, Ingersoll Rand, Patterson, Taco, Weinman.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Equipment Mounting:
 - 1. Type A Pumps:
 - a. Install base-mounted pumps on existing cast-in-place concrete equipment bases.
 - b. Comply with requirements for vibration isolation control devices specified in Section 23 05 48 "Mechanical Sound and Vibration Controls."
- E. Pipe condensation drain pans to nearest floor drain using 1/2-inch galvanized piping. Provide protective ramps in aisles.

3.3 ALIGNMENT

- A. Perform alignment service.
- B. After final connection of piping, grouting of base, and adjustment of vibration isolation, comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Where installing piping adjacent to pump, allow space for service and maintenance.

- B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- C. Install suction and discharge pipe sizes equal to sizes indicated on drawings.
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

- A. 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. 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.
 - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 6. Start motor.
 - 7. Open discharge valve slowly.

3.6 DEMONSTRATION

Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 23 21 23

SECTION 23 31 13 - DUCTS AND DUCT ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Sheet metal ductwork, smoke detector installation, and leakage testing.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Section 23 05 00 - Basic Mechanical Materials and Methods
- C. Section 23 05 93 – Testing, Adjusting, and Balancing
- D. Section 23 07 00 - Mechanical Insulation
- E. Section 23 09 23 - HVAC Instrumentation and Controls

1.3 QUALITY ASSURANCE

- A. For details not specified, such as hangers, elbow construction, offsets, obstruction streamlining, branch connections, dampers, sealing, the following reference applies:

Sheet Metal and Air Conditioning Contractors National Association "HVAC Duct Construction Standards, Metal and Flexible," Third Edition, 2005 referred to herein as SMACNA-HVAC.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00.
- B. Statement indicating compliance with SMACNA standards and specified system pressure ratings.
- C. Manufacturer's technical product data, installation instructions and accessories for the following:
 - Access Doors
 - Balancing Volume Dampers
 - Sealant Compound

1.5 APPLICABLE PUBLICATIONS

The publications form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

- A. Physical Interference: Provide offsets or changes in duct shape required to avoid structural or other interference without additional cost to the Contracting Officer's Representative (COR).
- B. Ductwork dimensions indicated on the drawings are internal.
- C. System Pressure Rating: Construct systems in accordance with the following pressure rating.

SYSTEM	PRESSURE RATING (INCHES- W.G.)
Exhaust Air	(-)1

PART 2 - PRODUCTS

2.1 FITTINGS AND ACCESSORIES

- A. Elbows
 - 1. Provide 90-degree elbows of radius construction wherever space permits and elsewhere of square construction. Construct 90-degree square elbows with double radius turning vanes unless otherwise indicated. If throat radius on curved elbows must be less than duct width, provide full-length metal turning vanes. Provide 3/4-inch trailing edge on turning vanes of 90 degree square elbows wherever elbow is less than one duct perimeter upstream of change in duct size or direction.
 - 2. Where a size change must occur at a square elbow, extend runners from throat to heel and secure vanes on runners parallel with duct sides.
 - 3. Unless otherwise indicated, provide offsets with 30-degree full radius elbows as maximum.
- B. Flexible Collars: Provide 6-inch wide neoprene impregnated glass fabric collars between fans and ducts or casings, and wherever ducts cross building expansion joints. Collars shall have flame retardant to have flame spread index not over 25 and a smoke developed index not over 50.
- C. Duct Access Door Construction: SMACNA-HVAC, Fig. 7-2, Door A, Frame 1, Hinge Position 1 for 2-inch w.g. static pressure rating and less.
- D. Balancing Volume Dampers
 - 1. Pressure Rating 2-inch W.G. and Less: SMACNA-HVAC, 7-4 A, B, C, 12-inch maximum blade width no internal frame. Fig. 7-5, multi opposed blade larger than 12-inch duct height, 8-inch maximum blade width. Recess frame totally out of airstream. Limit stop penetration into airstream to 1/2-inch. Dampers less than 5 feet upstream of outlets, equivalent to Young Regulator No. 820.
 - 2. Locate where accessible for adjusting after completion of work. Provide access panels where regulators are concealed. Provide damper regulators equal to "Ventlok" models listed.
 - a. Concealed or Exposed in Unfinished Space: No. 641.
 - b. Exposed in Finished Space: No. 688.
 - c. Manufacturers: Ventfabrics, Young Regulator.

- E. Instrument Test Holes: Locate where accessible in main or major branch ducts and upstream of smoke detectors to permit measurement of fan air quantities according to ASHRAE Pitot tube method. Locate holes on more than two sides of larger duct if required by available Pitot tube length. Provide holes with 1-inch high Ventlok No. 699 instrument ports.

2.2 RECTANGULAR DUCTWORK - PRESSURE RATED 2-INCH W.G. AND LOWER

- A. Galvanized steel sheets reinforcing and companion angles, and hangers. Provide metal specification, gages and construction of seams, joints and reinforcing according to SMACNA-HVAC.

2.3 EXHAUST DUCTWORK

- A. Unless otherwise indicated, the requirements for minus 2-inch w.g. pressure duct construction apply.
- B. Material (except as otherwise indicated): Galvanized steel sheets, reinforcing and hangers.

2.5 GASKETS

3M Company EC-1202 tape sealer. Minimum size and thickness 1 by 1/8-inch.

2.6 SEALING COMPOUND

Childers CP-146, McGill Airseal Corp. "United Duct Sealer," Benj. Foster 32-14, Hardcast, Inc.

PART 3 - EXECUTION

3.1 FITTINGS AND ACCESSORIES

- A. Provide duct accessories of materials suited to duct materials; use galvanized steel accessories in galvanized steel ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- B. Vibration: Brace or reinforce ducts where necessary to overcome vibration, buckling or breathing.
- C. Install flexible connectors immediately adjacent to equipment in ducts associated with motorized equipment supported by vibration isolators.
- D. Balancing Volume Dampers
 1. Install a minimum of two duct widths from air outlet or inlet device.
 2. Mark balanced position.
 3. Elevate dial to face of insulation.

- E. Instrument Test Holes: Repair exposed edge of lining where installed in lined ductwork.

- F. Install airtight duct access doors in casings, plenums, and ducts to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. Downstream from turning vanes and equipment.
 - 2. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
 - 3. On sides of ducts where adequate clearance is available, otherwise locate on bottom of ducts.
 - 4. Install the following sizes for duct-mounting, rectangular access doors:
 - a. One-Hand or Inspection Access: 8 by 5 inches.
 - b. Two-Hand Access: 12 by 6 inches.
 - c. Head and Hand Access: 18 by 10 inches.
 - d. Head and Shoulders Access: 21 by 14 inches.
 - e. Body Access: 25 by 14 inches.
 - f. Body Plus Ladder Access: 25 by 17 inches.
 - 5. Install the following sizes for duct-mounting, round access doors:
 - a. One-Hand or Inspection Access: 8 inches in diameter.
 - b. Two-Hand Access: 10 inches in diameter.
 - c. Head and Hand Access: 12 inches in diameter.
 - d. Head and Shoulders Access: 18 inches in diameter.
 - e. Body Access: 24 inches in diameter.

3.2 RECTANGULAR DUCTWORK - PRESSURE RATED 2-INCH W.G. AND LOWER

- A. Construct ducts true to indicated dimensions, straight and smooth on inside with neatly finished airtight joints.
- B. Where rigid board insulation is applied, do not use cross break or bead construction.
- C. Construct the sides of a section of duct of gage specified for its maximum dimension.
- D. Seal transverse joints, fitting connections and snaplock seams in indoor ductwork with sealing compound and tape.
- E. Prepare surface of duct to receive epoxy coating.

3.3 EXHAUST DUCTWORK

Construct ducts true to indicated dimensions, straight and smooth on inside with neatly finished airtight joints.

3.4 GASKETS

Overlap gaskets at corners and ends.

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3.5 SEALING COMPOUND

Follow manufacturer's recommendations. If necessary to achieve an airtight joint, additionally apply duct tape to wet sealant compatible with the sealer used. Allow adequate curing time before pressurizing system.

END OF SECTION 23 31 13

SECTION 23 34 16 - FANS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Fans and fan performance criteria for air distribution, ventilation and exhaust systems. Fan performance criteria for fan application in air handling units.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Section 23 05 00 - Basic Mechanical Materials and Methods
- C. Section 23 05 93 - Testing, Adjusting and Balancing
- D. Section 23 09 23 - HVAC Instrumentation and Controls
- E. Section 23 31 13 - Ducts and Duct Accessories
- F. Division 26 - Electrical

1.3 QUALITY ASSURANCE

- A. Provide UL label on electric powered equipment or certification that equipment has been tested by a testing agency approved by local authority and is equivalent in safety to UL labeled equipment.
- B. Fans shall comply with performance requirements and shall be licensed to use AMCA Certified Rating Seal for sound and air pressure.
- C. Operating Limits: Classify according to AMCA 99.
- D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00.
- B. Manufacturer's technical product data, installation instructions, performance data, accessories, supports, fittings, finishes, construction details, and dimension of components for each type of product indicated and shall include the following:
 - 1. Certified fan performance curves with system specified rating and operating conditions indicated on the curve.
 - 2. Motor ratings and electrical characteristics, plus motor and electrical accessories. Brake horsepower rating with motor NEMA service factor calculations shall be provided.
 - 3. Fan class rating.

4. Dampers, including housings, and linkages.
5. Power, signal, and control wiring.
6. Operation and Maintenance Data: Include in emergency, operation and maintenance manuals.

1.5 APPLICABLE PUBLICATIONS

The publications listed in this section form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

Provide all materials and equipment specified in this section with performance requirements as stated herein or on the drawings.

PART 2 - PRODUCTS

2.1 FANS

- A. Provide fans complete with motors and drives. Type, capacity, wheel diameter, horsepower, special construction features and other requirements are scheduled on the drawings.
- B. The first critical speed of the fan shaft, wheel, and bearing arrangement shall be at least 125 percent of the maximum cataloged speed of the fan assembly.
- C. Fans shall be (1) catalog rated for 15 percent greater static pressure than specified at specified air volume, (2) selected so that the specified air volume is greater than that at the apex of the fan pressure volume curve, and (3) selected to provide stable operation down to 85 percent of design volume operating at the required speed for the specified conditions.
- D. Balance fans statically and dynamically for maximum rated speed.
- E. Fans shall have AMCA certified ratings for sound and air pressure. Submit for review pressure, volume and horsepower curves for all fans. Curves shall indicate fan class ratings and unstable operation area.
- F. Bearings shall have a minimum AFBMA B-10 life of 40,000 hours based on maximum cataloged speed for class indicated.
- G. Fans with motor operated dampers shall have access doors for access to both damper and motor.
- H. Type J1
 1. Centrifugal upblast power roof ventilator equal to Greenheck CUE-VG direct drive with:
 - a. Aluminum housing, removable for access to fan and drive, with wiring channel.
 - b. Gravity backdraft damper.
 - c. Non-overloading aluminum fan
 - d. Disconnect switch factory wired to motor.

- e. Vari-Green Electrically Commutated Motor.
 - f. Motor and drive in ventilated compartment out of main air stream.
 - g. Manufacturer vibration isolation and roof curb.
2. Manufacturers: Acme, Greenheck, Jenco Fan Co., Loren Cook, Penn.

PART 3 - EXECUTION

3.1 FANS

- A. Lubricate bearings for extended shutdown or storage and rotate shafts every four weeks until fans are put into permanent operation. Verify lubrication for bearings and other moving parts prior to fan startup.
- B. Bolt fans securely to supports.
- C. Install fan units with clearances for service and maintenance.
- D. Install ducts adjacent to fans to allow for service and maintenance of fans.
- E. Verify that shipping, blocking, and bracing are removed.
- F. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
- G. With fan drive disconnected from wheel, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation after electrical wiring is connected to the motor.

END OF SECTION 23 34 16

SECTION 23 64 16 – LIQUID WATER CHILLERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Building cooling refrigeration equipment and associated integral controls, supports, accessories and motors.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 01 - General Requirements
- B. Section 23 05 00 - Basic Mechanical Materials and Methods
- C. Section 23 05 48 - Mechanical Sound and Vibration Control
- D. Section 23 05 93 - Testing, Adjusting, and Balancing
- E. Section 23 07 00 - Mechanical Insulation
- F. Section 23 09 23 - HVAC Instrumentation and Controls
- G. Section 23 20 00 - Building Services Piping
- H. Section 23 21 16 - Hydronic Piping Specialties
- I. Section 23 21 23 - Hydronic Pumps
- J. Division 26 - Electrical

1.3 QUALITY ASSURANCE

- A. Equipment specified shall meet all requirements of ASHRAE Standard 90.1, latest version.
- B. Provide UL label on electric powered equipment or certification that equipment has been tested by a testing agency approved by local authority and is equivalent in safety to UL labeled equipment.
- C. AHRI rating and certification.
- D. Chillers shall meet the requirements of ASHRAE Standard 15.

1.4 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00.

- B. Manufacturer's technical product data, installation instructions, performance data, accessories, supports, fittings, finishes, construction details, and dimension of components. Submittal shall include control cabinet layout and electrical wiring diagram.

Water Cooled Chillers

- C. AHRI Certification and test reports.

1.5 APPLICABLE PUBLICATIONS

The publications listed in this section form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation.

1.6 PROJECT CONDITIONS

Provide all materials and equipment specified in this section with performance requirements as stated herein or on the drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified warranty period.
1. Extended warranties include, but are not limited to, the following
 - a. Complete chiller including refrigerant and oil charge.
 - b. Complete compressor and drive assembly including refrigerant and oil charge.
 - c. Refrigerant and oil charge.
 - (1) Loss of refrigerant charge for any reason due to manufacturer's product defect and product installation.
 2. Warranty Period: 4 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WATER COOLED SCREW CHILLER

- A. Manufacturers: Carrier, Daikin Applied, Trane, York
1. Provide chiller(s) as indicated, including starters, refrigerant, oil piping, tool board with special tools, and control wiring. Refrigerant must be HFO-513A.
 2. Provide chiller(s) with duty as scheduled on the drawings.
 3. Capacity shall be based on a fouling factor for all water or glycol circuits of 0.00025 on the condenser and 0.0001 on the evaporator.

4. Helical rotary chillers must be designed, rated and certified in accordance with AHRI 550/590 and shall bear AHRI label. When specified for glycol and low temperature application, the AHRI rating shall be for water and adjusted for glycol and low temperature conditions
5. Helical rotary screw chillers must be tested at the factory in accordance with AHRI 550/590. The test data shall include the following in addition to AHRI requirements.
 - a. Calculation indicating correction for fouling factor, test stand flow and non-standard AHRI conditions to establish the test condition that is noted as "Design" for AHRI test chiller including refrigerant and oil charge.
 - b. The AHRI test data form shall also indicate the operating condition specified for this project.
 - c. The AHRI test form shall also, in addition to chiller's serial number, include the number that is assigned to the chiller for this project (i.e., Chiller No. 1, 2 etc).
6. Wiring Diagram
 - a. Submit a complete composite wiring diagram of the water chiller(s), the chilled and condenser water pumps, the cooling tower fan(s) and all auxiliary devices associated with the chilled water system. Diagram shall show power and control wiring, all interlocks, safety devices, controls, etc.
 - b. Do no work until diagram has been reviewed by Engineer.
 - c. Incorporate diagram in the Operating and Maintenance Manual.
7. Compressor
 - a. Field serviceable semi-hermetic / hermetic variable speed screw.
 - b. Casing: Cast iron, precision machined for minimum clearance about periphery of rotors
8. Compressor motor:
 - a. Must be semi-hermetic, squirrel case, induction-type motor with inherent thermal protection on all three phases and cooled by suction gas.
 - b. Motor controller must be equipped with a VFD providing speed compressor speed control as a function of the cooling load. VFD must provide protection for the following conditions:
 - (1) Electronic thermal overload
 - (2) Over/under current
 - (3) Stalled motor
 - (4) Input and output phase loss
 - (5) High load current
 - (6) Current imbalance
9. Oil Lubrication System: Consisting of pump if required, filtration, heater, cooler, factory-wired power connection, and controls.
10. Evaporator and Condenser
 - a. Shell-and-tube design, with water in the tubes and refrigerant surrounding tubes within shell
 - b. Construct and provide safety devices in conformance with ASME Code. Waterside shall be suitable for 150 psi working pressure and shall bear ASME Inspection Certification where required by code.

- c. Water boxes must have dished heads with valved drain and vent connections. Provide flanged connections or flanged elbows to permit mechanical cleaning of tubes without dismantling piping.
 - d. Evaporator shall be factory insulated with 1-1/2-inch flexible foamed plastic or field insulated as specified under Section 23 07 00, "Mechanical Insulation."
 - e. Condenser must have re-seating type spring loaded pressure relief valves according to ASHRAE 15 safety code. The condenser must be provided with dual relief valves equipped a transfer valve so one relief valve can be removed for testing or replacement without loss of refrigerant removal of refrigerant from the condenser. Rupture disks are not acceptable
 - f. Flow Sensor: Thermal dispersion type, factory calibrated for project specific application
11. Refrigerant circuit accessories shall include combination filter-dryer(s), solenoid liquid stop valve(s), liquid line sight glass(es), expansion valve(s), and suction and discharge valves on the compressor.
12. Controls
- a. Control enclosures shall be NEMA 1. The chiller shall have distributed control consisting of a color touch screen unit controller for operator interface with the control system.
 - b. Power supply must be high short circuit current rated panel with factory mounted single point unit disconnect circuit breaker
 - c. Equipment protection functions controlled by the microprocessor must include:
 - (1) High discharge pressure
 - (2) Loss of refrigerant
 - (3) Loss of water flow
 - (4) Freeze protection
 - (5) Low refrigerant pressure
 - d. User controls must include
 - (1) Auto/stop switch
 - (2) Chilled water set-point adjustment
 - (3) Anti-recycle timer
 - (4) Water temperature setpoint
 - (5) Operating temperatures and pressures
 - (6) Diagnostic messages
 - e. Factory mounted DDC controller shall support operation on a BACnet®, Modbus®, or LONMARKS® network.
13. Provide services for startup, test, etc. as described under Part 3 - Execution.

PART 3 - EXECUTION

3.1 WATER COOLED SCREW CHILLER

A. Wiring Diagram

1. Submit a complete composite wiring diagram of the water chiller(s), the chilled water pumps and all auxiliary devices associated with the chilled water system. Diagram shall show power and control wiring, all interlocks, safety devices, controls, etc.
 2. Do no work until diagram has been reviewed by COR.
 3. Incorporate diagram in the Operating and Maintenance Manual.
- B. Install in accordance with manufacturer's recommendations.
- C. Manufacturer's Supervision: Furnish services of manufacturer's trained representative to supervise.
1. Testing machine(s) under pressure for leaks.
 2. Evacuation and dehydration of machine using manufacturer's high vacuum pump.
 3. Charging machine(s) with refrigerant.
 4. Starting machine(s).
 5. If liquid chillers are leak tested in factory and shipped to the job site under vacuum, steps 1 and 2 above do not apply, provided vacuum has not been broken. If vacuum has been broken, Steps 1 and 2 must be completed before charging and starting machine. Machines must be tested with pressure gage to determine whether or not vacuum has been broken.
- D. Pipe discharge from pressure relief valve to exterior of the building. Provide flexible connection and piping to chillers in accordance with chiller manufacturer's recommendations and instructions. The discharge termination shall be located so as to avoid all safety hazards and shall be to atmosphere not less than 15 feet above ground and not less than 20 feet from windows, doors, and air intake openings.
- E. Flow switches for condenser and chilled water flow shall be installed in piping as indicated.
- F. Provide metal signs with minimum 0.5-inch letter designating main shutoff valves to each vessel, main electrical control, remote control switch and pressure limiting devices.
- G. Provide a sign outside the door to the refrigerant room giving direction for operation of the system and the following:
1. Instruction for shutting down the system in case of emergency.
 2. The name, address, and day and night telephone numbers for obtaining service.
 3. The name, address, and telephone number of the municipal inspection department having jurisdiction, and instructions to notify said department immediately in case of emergency.

END OF SECTION 23 64 16

SECTION 26 00 50 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

1.2 DESCRIPTION OF WORK

A. Requirements of this Section are applicable to work in Divisions 26.

B. Contract Documents

1. Contract drawings for electrical work are diagrammatic, intended to convey scope and general arrangement.
2. Refer questions involving document interpretation or discrepancies to Engineer for review and direction.
3. Correct faulty work due to resolving discrepancies without proper approval.
4. Specifications establish quality of materials, equipment, workmanship and methods of construction.
5. Follow drawings and specifications in laying out work. Consult other applicable contract drawings and specifications, become familiar with conditions affecting work.

C. Scope

1. The work in Division 26 includes furnishing and installing the electrical work complete and ready for satisfactory service.

D. Definitions: The following are definitions of terms and expressions used in Division 26.

1. "Accessible" – Capable of being removed or exposed without damaging the building or structure or finish or not permanently closed in by other equipment or by the structure or finish of the building.
2. "Approve" - To permit use of material, equipment or methods conditional upon compliance with contract document requirements.
3. "Concealed" - Hidden from normal sight; includes work in crawl spaces, above ceilings, and in building shafts.
4. "Directed" - directed by Engineer.
5. "Equal, equivalent" - possessing the same performance qualities and characteristics and fulfilling the same utilitarian function.
6. "Exposed" - not concealed.
7. "Furnish" - Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar operations.
8. "Indicated" - indicated in Contract Documents.

9. "Install" - Operations at project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning and similar operations.
10. "Provide" - furnish and install, complete and ready for the intended use.
11. "Removable" - detachable from the structure or system without physical alteration of materials or equipment and without disturbance to other construction.
12. "Review" - limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

1.3 QUALITY ASSURANCE

- A. Regulations: Comply with regulations of NFPA, state, county, and municipal building ordinances, and other applicable codes and regulations.
- B. Provide UL label on electric powered equipment or certification that equipment has been tested by a testing agency approved by the local authority as equivalent in safety to UL labeled equipment.
- C. Material and Equipment Requirements
 1. All materials and equipment shall be new and free from defects.
 2. Use products of one manufacturer where two or more items of same kind of equipment are required.
 3. For certain items of equipment, the specification and the project design are based upon the specified manufacturer's product. Other manufacturers' names are listed. Contractor may purchase, conditional upon meeting project requirements, equipment from the listed manufacturers.
 4. Only the manufacturer's equipment upon which, the specification and the project design has been based, has been checked for this project. Check allocated space and structure for suitability of equipment of other listed manufacturers, including parts replacement and servicing.
- D. Workmanship
 1. Remove and replace, at no extra cost, work not in conformance with contract requirements.
 2. Coordination with Other Trades
 - a. Coordinate work and cooperate with other trades to facilitate execution of work.
 - b. Give full cooperation and coordination with other trades and furnish information necessary to permit the work of all trades to be installed satisfactorily with the least possible interference or delay.
 - c. Furnish to other trades, as required, necessary templates, patterns, setting plans and shop details for the proper installation of the work and for the purpose of coordinating adjacent work.
 3. Accessible Equipment and Systems: Consider all materials and equipment installations and coordinate with the work of other trades to ensure equipment or systems are accessible for operations, maintenance, repairs, and replacement. Install materials and equipment, including but not limited to, supports and electrical conduit, to permit

complete unobstructed access to panelboards, transformers, and other items requiring access for inspection, maintenance, and operations. The installation of new equipment or materials which renders new or existing equipment inaccessible will be disapproved by the Engineer and shall be corrected by the Contractor.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Penetration Firestopping."
- E. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
 - 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Elevators.
 - b. Fire-alarm systems.

1.5 SHOP DRAWINGS AND SUBMITTALS PROCUDURES

- A. Refer to Division 01 for complete requirements.
- B. Submit all products for a single specification section as a complete submittal. All products specified within a division shall be included, otherwise submittal will be returned as incomplete.
- C. Clearly mark submittals to indicate actual intended products to be utilized. Marks may include highlighting, circling, boxing, checking, etc. Do not provide submittal data which lists multiple product's options and features without clearly indicating which data applies to the products intended to be used on project.

- D. Coordinate drawings and data before submitting and certify that provisions of the contract documents have been met.
- E. Call attention, in writing, to deviations from contract requirements.
- F. Do not fabricate, deliver to site, or install items requiring shop drawing review, until the review has been completed by the Engineer and the shop drawing has been marked to indicate "No Exception Taken" or "Make Corrections Noted."
- G. Use only final or corrected drawings and data for construction. This includes all Addendums, Architectural Supplemental Information (ASIs), and Change Bulletins.
- H. The Engineer's review of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL 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 electrical 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.
- F. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.
- G. Conditions of Occupancy
 - 1. This building will be occupied during the life of this contract. Execute work in a manner to impose minimal interference with the normal functioning of the building and its occupants. When interference is unavoidable, schedule work 14 days in advance with the Owner.

2. Make temporary connections where necessary to maintain uninterrupted electrical service.
3. Provide adequate protection for the building, its contents, and occupants.
4. Perform work as quietly as possible to avoid unnecessary disturbance. Unusual precaution may be necessary in the conduct or work in some areas to achieve satisfactory compliance.
5. Coordinate with Owner to Perform work producing high noise levels, dust, or hazards to occupants in occupied during non-business hours of the facility.
6. Comply with regulations of Owner pertaining to circulation, sanitation, and behavior of Contractor's personnel.

3.2 FIRESTOPPING

Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Penetration Firestopping."

END OF SECTION 26 00 50

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper building wire.
 - 2. Connectors and splices.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Copper building wire.
 - 2. Connectors and splices.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire; brand of Belden, Inc.
 - 2. Belden Inc.
 - 3. Cerro Wire LLC.
 - 4. Encore Wire Corporation.
 - 5. General Cable; Prysmian Group North America.
 - 6. Okonite Company (The).
 - 7. Service Wire Co.
 - 8. Southwire Company, LLC.
 - 9. WESCO.
- C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
1. Type THHN and Type THWN-2. Comply with UL 83.
 2. Type TC-ER. Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
- F. Shield:
1. Type TC-ER: Cable designed for use with ASDs, with oversized crosslinked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- 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. 3M Electrical Products.
 2. ABB, Electrification Business.
 3. AFC Cable Systems; Atkore International.
 4. Gardner Bender.
 5. Hubbell Utility Solutions; Hubbell Incorporated.
 6. ILSCO.
 7. Ideal Industries, Inc.
 8. NSi Industries LLC.
 9. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 10. Service Wire Co.
 11. TE Connectivity Ltd.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
 2. Type: Two hole with long barrels.
 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. VFD Output Circuits Cable: Extra-flexible stranded for all sizes.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Branch Circuits: Type THHN/THWN-2, single conductors in raceway.
- C. VFD Output Circuits: Type TC-ER cable with dual tape shield.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. 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.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL 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 Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Grounding and bonding conductors.
 2. Grounding and bonding clamps.
 3. Grounding and bonding bushings.
 4. Grounding and bonding hubs.
 5. Grounding and bonding connectors.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment Grounding Conductor:
1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. ASTM - Bare Copper Grounding and Bonding Conductor:
1. Referenced Standards: Complying with one or more of the following:
 - a. Soft or Annealed Copper Wire: ASTM B3
 - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
 - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
 - d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.3 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.4 GROUNDING AND BONDING HUBS

- A. Description: Hubs with certified grounding or bonding locknut.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.5 GROUNDING AND BONDING CONNECTORS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding and bonding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GROUNDING AND BONDING CONDUCTORS

- A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
- B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
- C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
- D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
- E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
- F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

3.3 SELECTION OF CONNECTORS

- A. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Connections to Structural Steel: Welded connectors.

3.4 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. Conductors:

- a. 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.
2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - f. 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 adjacent parts.
 - 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
 - g. Grounding and Bonding for Piping:
 - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where 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 bolted connector.
 - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
 - h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
3. Equipment Grounding and Bonding:
 - a. Install insulated equipment grounding conductors with feeders and branch circuits.

- b. Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.5 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.

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. ABB, Electrification Business.
 - b. Allied Tube & Conduit; Atkore International.
 - c. CADDY; brand of nVent Electrical plc.
 - d. Cooper B-line; brand of Eaton, Electrical Sector.
 - e. Flex-Strut Inc.
 - f. G-Strut.
 - g. Gripple Inc.
 - h. Haydon Corporation.
 - i. MIRO Industries.
 - j. Metal Ties Innovation.
 - k. Rocket Rack; Robroy Industries.
 - l. Unistrut; Atkore International.
 - m. Wesanco, Inc.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- D. 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.
 - 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) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 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) Cooper B-line; brand of Eaton, Electrical Sector.
 - 2) Empire Industries, Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 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.
 - 6. Toggle Bolts: Stainless steel springhead type.
 - 7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA NEIS 101
- 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 raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
- E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as scheduled in NECA NEIS 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size must be 1/4 inch in diameter.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT IMC and ERMC may be supported by openings through structure members, in accordance with NFPA 70.
- C. 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 must be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical 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: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: 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 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69, or Spring-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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 PAINTING

- A. Touchup:
1. 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.
 - a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 26 05 29

SECTION 26 05 33.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S duct raceways.
4. Type LFMC duct raceways.
5. Fittings for conduit, tubing, and cable.
6. Electrically conductive corrosion-resistant compounds for threaded conduit.

1.2 DEFINITIONS

- A. Conduit: A structure containing one or more duct raceways.
- B. Duct Raceway: A single enclosed raceway for conductors or cable.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S duct raceways.
4. Type LFMC duct raceways.
5. Fittings for conduit, tubing, and cable.
6. Electrically conductive corrosion-resistant compounds for threaded conduit.

PART 2 - PRODUCTS

2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FJMX; including UL 797.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

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. Allied Tube & Conduit; Atkore International.
 - b. Calconduit; Atkore International.
 - c. Emerson Electric Co., Automation Solutions.
 - d. Picoma; Zekelman Industries.
 - e. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
 - f. Topaz Lighting & Electric.
 - g. Western Tube; Zekelman Industries.
 - h. Wheatland Tube; Zekelman Industries.
2. Material: Steel.
3. Options:
 - a. Exterior Coating: Zinc.
 - b. Interior Coating: Zinc with organic top coating.
 - c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.2 TYPE ERMC-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYIX; including UL 6.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

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. Allied Tube & Conduit; Atkore International.
 - b. Calconduit; Atkore International.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

- e. Patriot Aluminum Products, LLC.
 - f. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
 - g. Topaz Lighting & Electric.
 - h. Western Tube; Zekelman Industries.
 - i. Wheatland Tube; Zekelman Industries.
2. Exterior Coating: Zinc.
 3. Options:
 - a. Interior Coating: Zinc with organic top coating.
 - b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 TYPE FMC-S DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXUZ; including UL 1.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):

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. ABB, Electrification Business.
 - b. Anaconda Sealtite; Anamet Electrical, Inc.
 - c. Electri-Flex Company.
 - d. International Metal Hose Co.
 - e. Penn Aluminum Conduit & EMT; Penn Aluminum International LLC; Berkshire Hathaway.
 - f. Topaz Lighting & Electric.
2. Material: Steel.
3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 TYPE LFMC DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXHR; including UL 360.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):

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. ABB, Electrification Business.
 - b. Anaconda Sealtite; Anamet Electrical, Inc.
 - c. Electri-Flex Company.
 - d. International Metal Hose Co.
2. Material: Steel.
3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.5 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DWTT - Fittings for Type ERMC Raceways:

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. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. Konkore Fittings; Atkore International.

- e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - f. Penn Aluminum Conduit & EMT; Penn Aluminum International LLC; Berkshire Hathaway.
 - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Southwire Company, LLC.
 - i. Topaz Lighting & Electric.
 2. Listing Criteria: UL CCN DWTT; including UL 514B.
 3. Options:
 - a. Material: Steel or Die cast.
 - b. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
- D. UL FKA V - Fittings for Type EMT Duct Raceways:
 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. ABB, Electrification Business.
 - b. Allied Tube & Conduit; Atkore International.
 - c. Appleton; Emerson Electric Co., Automation Solutions.
 - d. Calconduit; Atkore International.
 - e. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Southwire Company, LLC.
 - i. Topaz Lighting & Electric.
 2. Listing Criteria: UL CCN FKA V; including UL 514B.
 3. Options:
 - a. Material: Steel or Die cast.
 - b. Coupling Method: Compression Coupling or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
- E. UL ILNR - Fittings for Type FMC Raceways:
 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 Fittings Corp. (AMFICO).
 - b. Liquid Tight Connector Co.
 - c. Southwire Company, LLC.
 2. Listing Criteria: UL CCN ILNR; including UL 514B.

F. UL DXAS - Fittings for Type LFMC Raceways:

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. Arlington Industries, Inc.
 - b. Liquid Tight Connector Co.
2. Listing Criteria: UL CCN DXAS; including UL 514B.

2.6 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL FOIZ - Electrically Conductive Corrosion-Resistant Compound for Threaded Conduit:

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. ABB, Electrification Business.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
 1. Exposed: ERMC.
 2. Concealed Aboveground: ERMC.

3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:

1. Exposed: EMT.
2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Damp or Wet Locations: ERMC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC.

D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
2. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
3. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
4. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
5. Expansion Fittings: NEMA FB 2.40.
6. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

- a. Complete duct raceway installation before starting conductor installation.
- b. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
- c. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- d. Support conduit within 12 inch of enclosures to which attached.
- e. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
- f. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:

- 1) Conduit extending from interior to exterior of building.

- 2) Conduit extending into pressurized duct raceway and equipment.
 - 3) Where otherwise required by NFPA 70.
 - g. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
 - h. Keep duct raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
 - i. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - j. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
 - k. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - 1) Termination fittings with shoulders do not require two locknuts.
 - l. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts.
2. Types ERM and IMC:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
 3. Types FMC and LFMC:
 - a. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 4. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.
 5. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
 - a. EMT: Provide compression, steel or cast-metal fittings. Comply with NEMA FB 2.10.
 - b. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

6. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.
7. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.
 - a. Provide warning signs.

D. Interfaces with Other Work:

1. Coordinate with Section 078413 "Penetration Firestopping" for installation of firestopping at penetrations of fire-rated floor and wall assemblies.
2. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 26 05 33.13

SECTION 26 05 33.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. 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. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.

- c. Arlington Industries, Inc.
- d. Crouse-Hinds; brand of Eaton, Electrical Sector.
- e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- h. MonoSystems, Inc.
- i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
- j. Pass & Seymour; Legrand North America, LLC.
- k. Patriot Aluminum Products, LLC.
- l. Plasti-Bond; Robroy Industries.
- m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- n. Spring City Electrical Manufacturing Company.
- o. Topaz Lighting & Electric.
- p. Wiremold; Legrand North America, LLC.

3. Options:

- a. Material: Sheet steel.
- b. Sheet Metal Depth: Minimum 2 inch.
- c. Cast-Metal Depth: Minimum 2.4 inch.

C. UL QCIT - Metallic Conduit Bodies:

- 1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

D. UL QCIT - Metallic Device Boxes:

- 1. Description: Box with provisions for mounting wiring device directly to box.
- 2. Options:
 - a. Material: Sheet steel.
 - b. Sheet Metal Depth: minimum 2 inch.
 - c. Cast-Metal Depth: minimum 2.4 inch.

2.2 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

B. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:

- 1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. 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. Adalet.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Cooper B-line; brand of Eaton, Electrical Sector.
 - d. FSR Inc.
 - e. Hoffman; brand of nVent Electrical plc.
 - f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Milgard Manufacturing, LLC.
 - i. N J Sullivan Company.
 - j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - l. Spring City Electrical Manufacturing Company.
 - m. Square D; Schneider Electric USA.

3. Options:
 - a. Degree of Protection: Type 1 and Type 12.

C. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. 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. Adalet.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Cooper B-line; brand of Eaton, Electrical Sector.
 - d. FSR Inc.
 - e. Hoffman; brand of nVent Electrical plc.
 - f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Milgard Manufacturing, LLC.
 - i. N J Sullivan Company.
 - j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - l. Spring City Electrical Manufacturing Company.
 - m. Square D; Schneider Electric USA.
3. Options:

- a. Degree of Protection: Type 4X.

2.3 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

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. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Intermatic, Inc.
 - h. Leviton Manufacturing Co., Inc.
 - i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - j. Panduit Corp.
 - k. Pass & Seymour; Legrand North America, LLC.
 - l. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - m. Topaz Lighting & Electric.
 - n. Wiremold; Legrand North America, LLC.
2. Options:
 - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - b. Interior Wallplate Material: Galvanized steel.
 - c. Exterior Wallplate Material: Cast aluminum.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:
 - a. Type 4 unless otherwise indicated.
2. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Damp or Dusty Locations: Type 3R.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:

1. Provide cast-metal boxes.
2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.

C. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. 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 of box unless otherwise indicated.
3. 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 surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
10. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

- a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
- b. Provide gaskets for wallplates and covers.

11. Identification: Provide labels for boxes and associated electrical equipment.

- a. Identify field-installed conductors, interconnecting wiring, and components.
- b. Provide warning signs.
- c. Label each box with engraved metal or laminated-plastic nameplate.

3.3 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.4 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 26 05 33.16

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve-seal Systems.
4. Sleeve-seal fittings.
5. Grout.

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.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Steel Wall Sleeves:

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. Advance Products & Systems, LLC.
 - b. CCI Piping Systems.
 - c. Flexicraft Industries.
 - d. GPT; an EnPro Industries company.
2. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

2.2 RECTANGULAR SLEEVES

A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:

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. Abesco Fire LLC.
 - b. Specified Technologies, Inc.
 - c. Wiremold; Legrand North America, LLC.

2. General Characteristics:

- a. Material: Galvanized sheet steel.
- b. Minimum Metal Thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inch and with no side larger than 16 inch, thickness must be 0.052 inch.
 - 2) For sleeve cross-section rectangle perimeter not less than 50 inch or with one or more sides larger than 16 inch, thickness must be 0.138 inch.

2.3 SLEEVE-SEAL 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. Advance Products & Systems, LLC.
 - 2. BWM Company.
 - 3. CALPICO, Inc.
 - 4. Flexicraft Industries.
 - 5. GPT; a division of EnPRO Industries.
 - 6. Metraflex Company (The).
 - 7. Proco Products, Inc.
- B. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
- C. Options:
 - 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: Carbon steel or Stainless steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- 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. Holdrite; a division of Reliance Worldwide Corporation.
- B. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- 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. W. R. Meadows, Inc.
- B. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 - 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - 2. Design Mix: 5000 psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - 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 raceway or cable, unless sleeve-seal system is to be installed.
 - 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.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 26 05 44

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Labels.
 2. Bands and tubes.
 3. Tapes and stencils.
 4. Tags.
 5. Signs.
 6. Cable ties.
 7. Miscellaneous identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
1. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.
- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
1. Safety Colors: NEMA Z535.1.
 2. Facility Safety Signs: NEMA Z535.2.
 3. Safety Symbols: NEMA Z535.3.
 4. Product Safety Signs and Labels: NEMA Z535.4.
 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 1000 V or Less:
1. Black letters on orange field.
 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
 2. Colors for 208Y/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 3. Colors for 480Y/277 V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 4. Color for Neutral: White.
 5. Color for Equipment Grounds: Green.
- C. Equipment Identification Labels:
1. Black letters on white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
 2. Marker for Labels:
 - a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

- D. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inch for raceway and conductors.
 - b. 3-1/2 by 5 inch for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.

2.6 TAGS

- A. Write-on Tags:
1. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
 2. Marker for Tags:
 - a. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
 2. Thickness:
 - a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. inch, 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Punched or drilled for mechanical fasteners with 1/4 inch grommets in corners for mounting.

- e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F.
 - 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- J. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
 - 1. "NORMAL POWER."
- K. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- L. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.
- M. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- N. Self-Adhesive Labels:
 - 1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.

- O. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- P. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- Q. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- R. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- S. Write-on Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using UV-stabilized cable ties.
- T. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
 - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.
- U. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:
 - 1. "NORMAL POWER."
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.

- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with conductor designation.
- F. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- G. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Enclosed controllers.
 - f. Variable-speed controllers.
 - g. Push-button stations.

END OF SECTION 26 05 53

SECTION 26 33 00 - HEAT TRACING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes piping heat tracing for freeze prevention with self-regulating, parallel resistance electric heating cables.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. 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.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Raychem XL-Trace. (Raychem is a division of Pentair Thermal Building Solutions).
 2. Chromolox.
 3. Thermon.
- B. Comply with IEEE 515.1.
- C. Heating Element: Radiation cross-linked, semi-conductive core extruded over two parallel, stranded 16 AWG bus wires. The heating element shall be of the self-regulating type, varying its power output inversely with pipe temperature at every point along its entire length such that power output is reduced as temperature increases and so that it can be cut to length in field without affecting power output per unit length. Terminate with waterproof, factory-assembled non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin or fluoropolymer.
- E. Cable Cover: Tinned-copper braid.
- F. Maximum Operating Temperature (Power On): 150 degrees F.
- G. Maximum Intermittent Exposure Temperature (Power Off): 185 degrees F.
- H. 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.
- I. Capacities and Characteristics:
 1. Maximum Heat Output: 8 W/ft.
 2. Piping Diameter: Refer to mechanical and plumbing drawings and specifications for information on piping diameter.
 - a. Volts: 120.
 - b. Phase: Single Phase.
 - c. Hertz: 60 Hz.

2.2 CONTROLS

- A. Ambient sensing thermostat with adjustable temperature range from 15 to 140 degrees F and properly sized contactor for power panel. Circuits shall be energized when ambient temperature drops to 40 degrees F.

- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Electrical heat tracing components, power connections, splices, tees and end seals shall be by the same manufacturer as the heat tracing cable and shall be approved by a certifying agency for installation in the designated areas.
- B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric heating cable according to manufacturer's written recommendations using slack cable to allow easy removal of maintenance items such as pumps, valves, strainers and filters without damage to the cable.
- B. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- C. Electric Heating-Cable Installation for Freeze Protection for Piping:
 - 1. Install electric heating cables after the completion of piping tests and piping rework to avert possible physical damage to the cables.
 - 2. Install cables before insulation is installed.
 - 3. Install electric heating cables according to IEEE 515.1.

4. Install insulation over piping with electric cables according to Division 23 Section "Mechanical Insulation."
5. Install warning tape on piping insulation where piping is equipped with electric heating cables.

- D. Protect installed heating cables, including non-heating leads, from damage.
- E. Do not use heat transfer cement of any type in electric heating cable installation.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction.
 2. Test cables for electrical continuity and insulation integrity before energizing.
 - a. Meggered the heater cable to verify no damage has occurred. Conduct test using a 2500 VDC megger. Do not use a megger with an excess of 2500 VDC for polymer heater cables. Minimum acceptable readings should be 20 megohms per circuit, regardless of length
 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously. Document measurements to verify the installation is functioning properly.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 PROTECTION

- A. Protect installed heating cables, including non-heating leads, from damage during construction.
- B. Remove and replace damaged heat-tracing cables.

END OF SECTION 26 33 00