



DEPARTMENT OF
AIRPORTS

SALT LAKE CITY INTERNATIONAL AIRPORT

PROJECT MANUAL FOR

**SLC AIRPORT – DOCK 3
DOOR REPLACEMENT
PROJECT NO. 542612
CONTRACT NO. CA-005864**

**DESIGN & CONSTRUCTION MANAGEMENT
DIVISION**

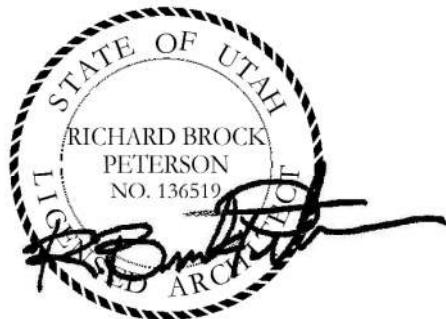
GSBS 
ARCHITECTS
GSBS Project No.2022.046.02

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1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect – GSBS Architects:

1. Richard Brock Peterson
2. 136519
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record below.



B. Structural Engineer: Dunn Associates

1. Tyler N. Wright
2. 187947
3. Responsible for Divisions 03, 05.



C. Mechanical Engineer: Resolute Group

1. Meta Joles
2. -
3. Responsible for Divisions 22, 23.

D. Electrical Engineer: Envision Engineering

1. Aleksandar Rankovic
2. 9808039-2202
3. Responsible for Divisions 26.



END OF DOCUMENT 000107

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**PROJECT NO. 54612
CONTRACT NO. CA--005864**

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SECTION 011000 - SUMMARY

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:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Work restrictions.
5. Specification and drawing conventions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: SLC Department of Airports – Dock 3 – Door Replacement.

1. Project Location: 3920 West Terminal Dr., Salt Lake City, Ut 84122.

- B. Owner: SLC Department of Airports. Owner's Representative: Erik Groethe (tel.801-575-2889).

- C. Architect: GSBS Architects; Brock Peterson (tel. 801-521-8600).

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

1. Structural Engineering: Dunn Associates; Jake Dunn (tel. 801-575-8877).
2. Mechanical Engineering: Resolut Group; Meta Joles (tel. 801-530-3148).
3. Electrical Engineering: Envision Engineers; Aleksandar Rankovic (tel. 801-534-1130).

- E. Project Information Exchange Site: A project Information Exchange site administered by Architect will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using the Project Web site.

SUMMARY

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1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Project consists of Dock 3 door replacement.
 - a. Replace single coiling door with two sectional overhead doors.
 - b. Relocation of existing lighting, mechanical equipment and fire sprinklers to accommodate the new sectional doors.
 - c. Installation of a new center steel tube column to provide jamb support for the new doors.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.5 ACCESS TO SITE

- 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. 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. Limits: Discuss with owner at start of the project, prior to construction, to determine limits of construction on the site.
 - 2. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

1.6 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

SUMMARY

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1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SUMMARY

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**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

SECTION 012500 - SUBSTITUTION 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 for substitutions.
- B. Related Requirements:
 - 1. Division 0 for requirements for substitution requests prior to award of Contract.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 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 Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form acceptable to Architect.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.

- b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 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.

1.5 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.

1.6 PROCEDURES

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SUBSTITUTION PROCEDURES

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**SLCDA – DOCK 3 DOOR REPLACEMENT
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SECTION 012600 - CONTRACT MODIFICATION 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 for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 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.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 10 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 012500 "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.

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
- 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records 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 012600

CONTRACT MODIFICATION PROCEDURES

012600 - 2

**SLCDA – DOCK 3 DOOR REPLACEMENT
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SECTION 012900 - 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 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 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. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.

PAYMENT PROCEDURES

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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. 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.

1.4 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 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.
 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.

PAYMENT PROCEDURES

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- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- 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 Architect by a method ensuring receipt. 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. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Sustainable design action plans, including preliminary project materials cost data.
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
 14. Certificates of insurance and insurance policies.
 15. Data needed to acquire Owner's insurance.
- I. 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 017700 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.

PAYMENT PROCEDURES

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

PAYMENT PROCEDURES

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**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

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 provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

- B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Key Personnel Names: Prior to commencement of the Work 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 inbuilt facility. Keep list current at all times.

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1.5 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. 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.

1.6 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. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.

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- e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
- f. Indicate required installation sequences.
- g. 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 and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Owner name.
 3. Owner's Project number.
 4. Name of Architect.
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 1. Attachments shall be electronic files in PDF format.

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- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven 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 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 5 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. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number, including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 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 three days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Architect's Data Files Not Available: Architect will provide Architect's digital data files for Contractor's use during construction.

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- B. Web-Based Project Management Software Package: Use Architect's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project management software includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.

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

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.
 - o. Use of the premises.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. 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. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. 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 Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, 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.

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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. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. 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 weekly intervals.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site use.

- 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of Proposal Requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
2. Section 014000 "Quality Requirements" for schedule of tests and inspections.
3. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.3 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. Predecessor Activity: An activity that precedes another activity in the network.
 - 2. Successor Activity: An activity that follows another activity in the network.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 1. Working electronic copy of schedule file.
 2. PDF file.

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- B. 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.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.
- D. Daily Construction Reports: Submit at monthly intervals.
- E. Material Location Reports: Submit at monthly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Unusual Event Reports: Submit at time of unusual event.
- H. Qualification Data: For scheduling consultant.

1.5 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.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
- 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. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.

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- 3. 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.
 - 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 - 5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 - 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- 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, Owner, 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.

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1.7 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.

1.8 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Testing and inspection.
 - 8. Accidents.
 - 9. Meetings and significant decisions.
 - 10. Unusual events.
 - 11. Stoppages, delays, shortages, and losses.
 - 12. Meter readings and similar recordings.
 - 13. Emergency procedures.
 - 14. Orders and requests of authorities having jurisdiction.
 - 15. Change Orders received and implemented.
 - 16. Construction Change Directives received and implemented.
 - 17. Services connected and disconnected.
 - 18. Equipment or system tests and startups.
 - 19. Partial completions and occupancies.
 - 20. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 - 1. Material stored prior to previous report and remaining in storage.
 - 2. Material stored prior to previous report and since removed from storage and installed.
 - 3. Material stored following previous report and remaining in storage.

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- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
 - 1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

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SECTION 013300 - SUBMITTAL 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 requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

- B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 014000 "Quality Requirements" for submitting test and inspection reports.
4. Section 017700 "Closeout Procedures" for submitting warranties.
5. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
6. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
7. Divisions 2 through 33 Sections for specific requirements for submittals in those Sections.

1.3 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."
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule 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: 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: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule 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.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data File: Electronic digital data file of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals as follows:
1. The Architect may furnish Contractor digital data drawing files of limited portions of the Contract Drawings for use in preparing Shop Drawings and Project record drawings with the following conditions:
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings will be made available in the current version of Autodesk AutoCad.
 - c. Contractor will execute a GSBS Architects Conditional Release Agreement.
- 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.

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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 different types of submittals for related parts of the Work 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, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Refer to the Electronic Submittal Flow Chart at the end of this section.
 2. Assemble complete submittal package into a single bookmarked file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 3. Name file as outlined in "Electronic Submittals Flow Chart" attached to the end of this section.
 4. Insert form for Contractor's review and approval markings and action taken by Architect attached to the end of this section.
 5. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.

- k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Submittal and transmittal distribution record.
 - p. Other necessary identification.
 - q. Remarks.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals: Make resubmittals in same form 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.
- H. 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.
- I. 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.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
- 1. Post electronic submittals as PDF electronic files directly to the GSBS Architect's Info Exchange Site specifically established for Project.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Certificates and Certifications Submittals: Provide 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.

SUBMITTAL PROCEDURES

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- B. 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 not suitable 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 written recommendations.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's catalog cuts.
 - d. Manufacturer's product specifications.
 - e. Standard color charts.
 - f. Mill reports.
 - g. Compliance with recognized trade association standards.
 - h. Compliance with recognized testing agency standards.
 - i. Testing by recognized testing agency.
 - j. Application of testing agency labels and seals.
 - k. Notation of coordination requirements.
 - l. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing 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 or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. Searchable PDF electronic file with bookmarks for all the sections.
- C. 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.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.

- l. Notation of dimensions established by field measurement.
 - m. Relationship and attachment to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 3. Submit Shop Drawings in the following format:
 - a. Searchable PDF electronic file with bookmarks for all the sections.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

- a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
- F. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."
- G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."
- H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."
- I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- J. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- M. 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.
- N. 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.
- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. 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.
- R. 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.
- S. 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:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- T. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 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 Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file 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.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action 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. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 1. Action Stamp: The Architect and/or Engineer will stamp each submittal with a uniform, action stamp. The Architect and/or Engineer will mark the stamp appropriately to indicate the action taken, as follows:
 - a. Final Unrestricted Release: When the Architect marks a submittal "Reviewed," the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
 - b. Final-But-Restricted Release: When the Architect marks a submittal "Furnish as Corrected," the work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
 - c. Returned for Resubmittal: When the Architect marks a submittal "Revise and Resubmit," do not proceed with work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark. Do not use, or allow others to use, submittals marked "Revise and Resubmit," at the Project Site or elsewhere where work is in progress.
 2. Returned for Alternate Submittal: When the Architect marks a submittal "Rejected," do not proceed with work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Product was not appropriate or as specified. Prepare a new submittal according to the Contract Documents; submit without delay.

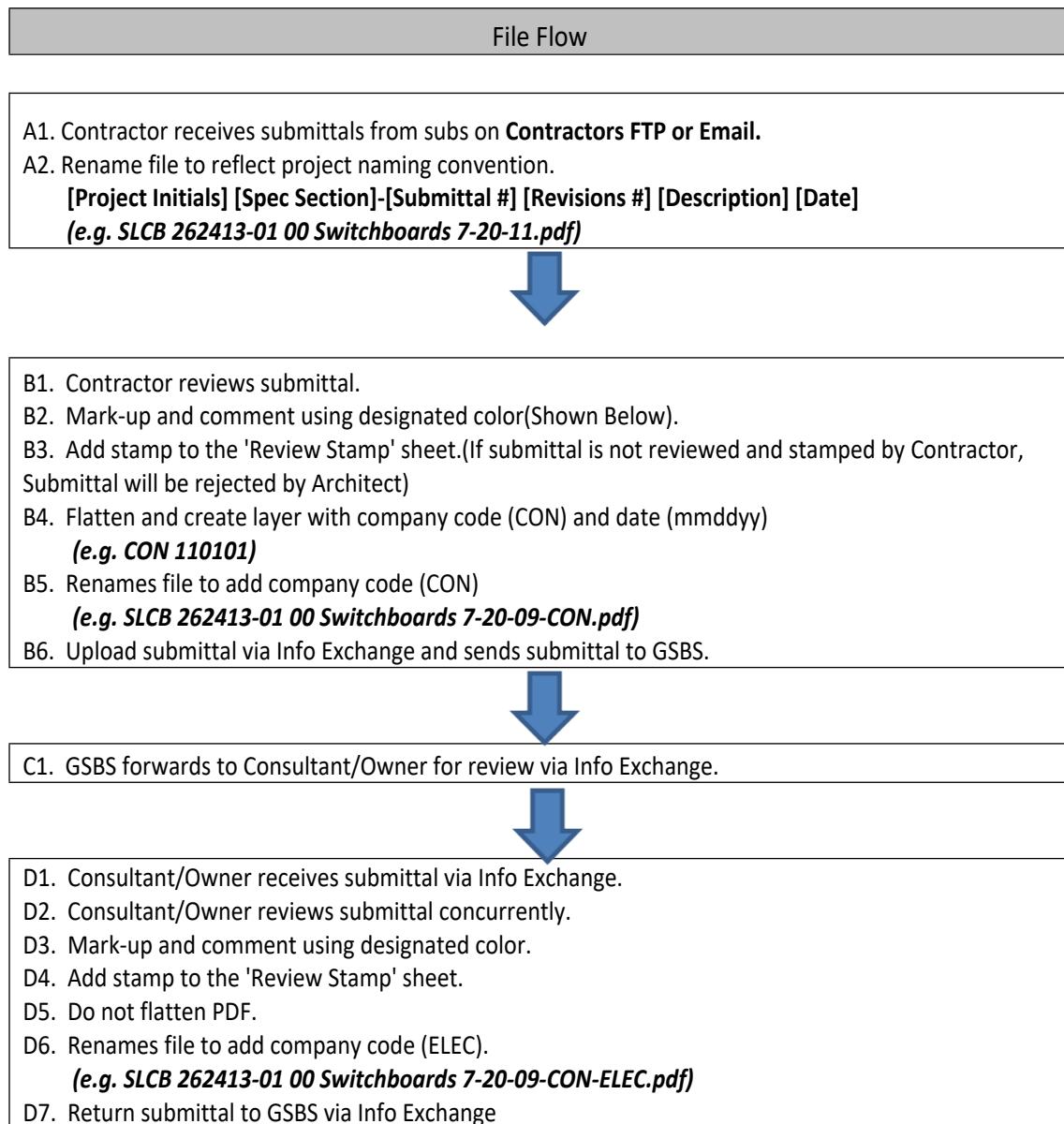
SUBMITTAL PROCEDURES

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SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02

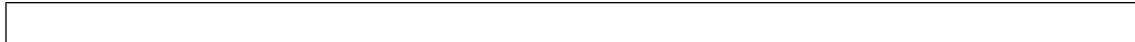
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Submittals not required by the Contract Documents may be returned by the Architect without action.

PART 4 - Electronic Submittal Flow Chart

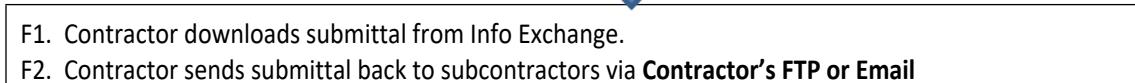


SUBMITTAL PROCEDURES

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- E1. GSBS combines consultant/owner comments from concurrent review.
- E2. GSBS flattens and creates layers for consultant/owners.
- E3. Mark-up and comment using designated color.
- E4. Add stamp to the 'Review Stamp' sheet.
- E5. Flatten and create layer with company code (GSBS) and date (yyymmdd)
- E6. Renames file to add company code (GSBS).
(e.g. SLCB 262413-01 00 Switchboards 7-20-09-CON-ELEC-GSBS.pdf)
- E7. Return submittal to Contractor via Info Exchange



- F1. Contractor downloads submittal from Info Exchange.
- F2. Contractor sends submittal back to subcontractors via **Contractor's FTP or Email**

Reviewer	Person	Code	Color
Contractor		CON	Green (10)
GSBS Architects		GSBS	Red (12)
Electrical Engineer		ELEC	Blue (11)
Mechanical Engineer		MECH	Orange (8)
Structural Engineer		STR	Maroon (7)
Landscape Architect		GSBS	Red (12)
Civil Engineer		CIV	Violet (13)
Audio/Visual Engineer		AV	Magenta (14)
Owner		OWN	Brown (1)
Furnishings- FFE		FFE	Cyan (17)
Security Access Control		SAC	Blue (6)



General Contractor

Architect

Consultant

Consultant

SUBMITTAL PROCEDURES

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SLCDA – DOCK 3 DOOR REPLACEMENT
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END OF SECTION 013300

SUBMITTAL PROCEDURES

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**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

REVIEW STAMPS FOR PROJECT:

Required Reviewers

ARCHITECTURAL	CIVIL	ACOUSTICAL	COMMISSIONING	AHJ
STRUCTURAL	INTERIORS	HARDWARE	OWNER	DETENTION
MECHANICAL	LANDSCAPE	A/V	SIGNAGE	
ELECTRICAL	KITCHEN PRODUCTS	ENVELOPE	SUSTAINABILITY	

GENERAL CONTRACTOR

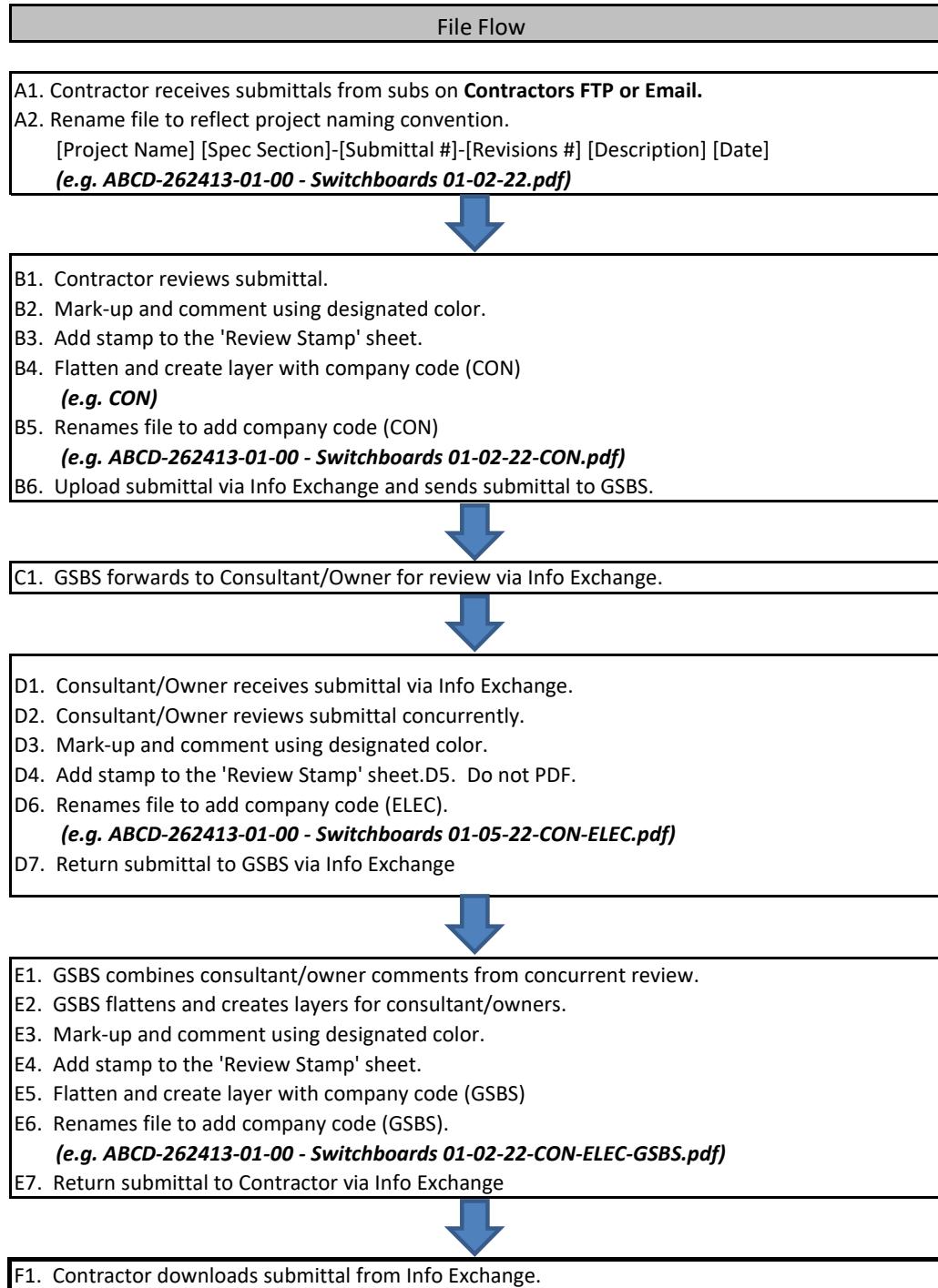
ARCHITECT

CONSULTANT

CONSULTANT

Electronic Submittal Flow Chart

01.02.2025



Reviewer	Person	Code	Color
Contractor		CON	Green (10)
GSBS Architects	Cathy Davison	GSBS	Red (12)
Electrical Engineer		ELEC	Blue (11)
Mechanical Engineer		MECH	Orange (8)
Structural Engineer		STRUC	Maroon (7)
Landscape Architect		GSBS	Red (12)
Civil Engineer		CVL	Violet (13)
Commissioning Agent		COMM	Magenta (14)
Owner		OWN	Brown (1)



SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. 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" has 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.

1.4 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.

1.5 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 is 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
- B. 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.
- C. 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.
- D. Reports: Prepare and submit certified written reports and documents as specified.
- E. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 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.

1.8 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.

QUALITY REQUIREMENTS

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- 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 be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
 - 1. Requirements of authorities having jurisdiction 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.

1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Refer to the Special Conditions 00810 for additional requirements.
 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. 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."
- E. 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.
- F. 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.
- G. 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.

- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
 2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

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

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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 017300 "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 014000

SECTION 014200 - REFERENCES

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 DEFINITIONS

- A.** **General:** Basic Contract definitions are included in the Conditions of the Contract.
- B.** **"Approved":** When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C.** **"Directed":** A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D.** **"Indicated":** Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E.** **"Regulations":** Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F.** **"Furnish":** Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G.** **"Install":** Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H.** **"Provide":** Furnish and install, complete and ready for the intended use.
- I.** **"Project Site":** Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 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.

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- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 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 indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- 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.

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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).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Utilize owner's existing systems for sewer usage by all entities for construction operations.
- C. Water Service: Utilize owner's existing systems for water used by all entities for construction operations.
- D. Electric Power Service: Utilize owner's existing systems for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

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

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

2.2 TEMPORARY FACILITIES

- A. Field Offices: Utilize construction zone to accommodate adequate space for the field office functions.
- B. Storage and Fabrication Sheds: Utilize construction zone to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Connect temporary service to Owner's existing power source, as directed by Owner.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi, cell phone access equipment for each field office.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
- I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.
- J. Project Computer: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
 - 1. Processor: Intel Core i5 or i7.
 - 2. Memory: 16 gigabyte.
 - 3. Disk Storage: 1 -terabyte hard-disk drive and combination DVD-RW/CD-RW drive.
 - 4. Display: 24-inch LCD monitor with 256-Mb dedicated video RAM.
 - 5. Full-size keyboard and mouse.
 - 6. Network Connectivity: Gigabit.
 - 7. Operating System: Microsoft Windows 10 Professional.
 - 8. Productivity Software:
 - a. Microsoft Office Professional, 2013 or higher, including Word, Excel, and Outlook.
 - b. Adobe Reader DC.
 - c. WinZip 10.0 or higher.
 - 9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 - 10. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 10.0 -Mbps upload and 15 -Mbps download speeds at each computer.
 - 11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 312000 "Earth Moving."
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- E. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - 3. Maintain and touch up signs, so they are legible at all times.

- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- F. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

- 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

- A. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- B. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.

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6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- C. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

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**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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 012500 "Substitution Procedures" for requests for substitutions.
 2. Section 014200 "References" for applicable industry standards for products specified.
 3. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 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 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.

- b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
- 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 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.
 - 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "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. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 3. Where products are accompanied by the term "as selected," Architect will make selection.
 - 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.

PRODUCT REQUIREMENTS

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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 012500 "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 owners, if requested.
 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

PRODUCT REQUIREMENTS

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**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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 Owner's portion of the Work.
6. Coordination of Owner-installed products.
7. Progress cleaning.
8. Starting and adjusting.
9. Protection of installed construction.

- B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting surveys.
2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
3. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 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.

1.4 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."

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- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. 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. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Equipment supports.
 - d. Piping, ductwork, vessels, and equipment.
 - e. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

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. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

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3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "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.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 2. Establish limits on use of Project site.
 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 4. Inform installers of lines and levels to which they must comply.
 5. Check the location, level and plumb, of every major element as the Work progresses.
 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

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- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

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.

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- 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. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 017700 "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.

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- 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.

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 015000 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "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 014000 "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 017300

SECTION 017419 - 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. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

1.6 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and

- B. 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.

PART 2 - PRODUCTS (Not Used)

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. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. 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.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be recycled.
 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 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.

1.4 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 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 Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner'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 Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
6. Advise Owner of changeover in utility services.

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7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 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.

1.8 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 012900 "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.
- 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.

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1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first, 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.

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. 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 uploading to web-based project software site.
- 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.

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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. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - l. Remove labels that are not permanent.

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- m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
 - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - r. Clean strainers.
 - s. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

- B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 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.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

- B. Format: Submit operation and maintenance manuals in the following format:

1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
 2. Submit two paper copies. Architect will return two copies.
- 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 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of contents. 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.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 8. 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."

1.7 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.
 - 7. Seasonal and weekend operating instructions.
 - 8. Required sequences for electric or electronic systems.
 - 9. Special operating instructions and procedures.

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- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.

- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.

- B. Record Specifications: Submit annotated PDF electronic files and paper copies of Project's Specifications, including addenda and Contract modifications.

- C. Record Product Data: Submit annotated PDF electronic files and directories and paper copies 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 and paper copies of each submittal.

1.4 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.
 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 013100 "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.
 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.

1.5 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.

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1.6 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.

1.7 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.

1.8 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

PROJECT RECORD DOCUMENTS

017839 - 4

**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 011000 "Summary" for items on the project to be salvaged.

1.2 DEFINITIONS

- A. Remove:** Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage:** Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for store.
- C. Existing to Remain:** Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- D. Dismantle:** To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A.** Unless otherwise indicated for salvage in Section 011000 "Summary", demolition waste becomes property of Contractor.
- B.** Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.
 - 6. Review site set-up and use requirements for the removal and haul-off of debris.

1.5 INFORMATIONAL SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property for dust control and for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's other tenants' on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Submit photographic documentation before Work begins.
- E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged for owner.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Refer to Section 011000 Summary, for items on the project to be salvaged.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that appropriate utilities have been disconnected and capped before starting selective demolition operations.
- B. Verify Utilities to remain uninterrupted and identify and protect them throughout the process of demolition and construction activities.
- C. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner/Architect does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Inventory and record the condition of items to be removed and salvaged.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off overall indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Comply with requirements for temporary enclosures, dust control, heating, and cooling.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for standard and approved time after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.
 - 1. Do not begin remodel operations and new construction which encapsulates dust, dirt and debris that originated with the demolition process.

END OF SECTION 024119

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural-steel materials.
 - 2. Shrinkage-resistant grout.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame and miscellaneous steel fabrications and other steel items not defined as structural steel.
 - 2. Section 099600 "High-Performance Coatings" for painting requirements.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- C. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 ACTION SUBMITTALS

- A. Product Data:

1. Structural-steel materials.
 2. High-strength, bolt-nut-washer assemblies.
 3. Shear stud connectors.
 4. Anchor rods.
 5. Threaded rods.
 6. Forged-steel hardware.
 7. Slide bearings.
 8. Shop primer.
 9. Galvanized-steel primer.
 10. Etching cleaner.
 11. Galvanized repair paint.
 12. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 5. Identify members and connections of the seismic-load-resisting system.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand-critical welds.
 8. Identify members not to be shop primed.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand-critical welds.
- D. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- C. Mill test reports for structural-steel materials, including chemical and physical properties.

D. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 4. Shear stud connectors.
- E. Survey of existing conditions.
- F. Source quality-control reports.
- G. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 1. ANSI/AISC 303.
 2. ANSI/AISC 341.
 3. ANSI/AISC 360.
 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

- A. Channels, Angles, Plates and Bar: ASTM A572/A572M, **Grade 50** (**Grade 345**).
- B. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
- C. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.
- D. Steel Forgings: ASTM A668/A668M.
- E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325** (**Grade A325M**), Type 3, heavy-hex steel structural bolts; **ASTM A563**, **Grade DH** (**ASTM A563M**, **Class 10S**), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A490** (**Grade A490M**), Type 3, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; **ASTM A563**, **Grade DH3** (**ASTM A563M**, **Class 10S**), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325** (**Grade A325M**), Type 1, heavy-hex steel structural bolts; **ASTM A563**, **Grade DH** (**ASTM A563M**, **Class 10S**), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.

2.4 RODS

A. Unheaded Anchor Rods: As indicated

1. Configuration: Straight.
2. Nuts: **ASTM A563 (ASTM A563M)** hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: **ASTM F436 (ASTM F436M)**, Type 1, hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

B. Headed Anchor Rods: As indicated, straight.

1. Nuts: **ASTM A563 (ASTM A563M)** hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: **ASTM F436 (ASTM F436M)**, Type 1, hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

C. Threaded Rods: ASTM A449/A449M.

1. Nuts: **ASTM A563 (ASTM A563M)** hex carbon steel.
2. Washers: **ASTM F436 (ASTM F436M)**, Type 1, hardened.
3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
2. Where finish requirements allow in other sections, provide fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#134.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: ASTM A780/A780M.

2.7 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 3.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.9 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.11 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of **2 inches (50 mm)**.
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces unless indicated to be painted.
 6. Corrosion-resisting (weathering) steel surfaces.
 7. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of **1.5 mils (0.038 mm)**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.
- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" or Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.
 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Miscellaneous steel trim including steel edgings.
5. Loose bearing and leveling plates for applications where they are not specified in other Sections.

- B. Products furnished, but not installed, under this Section:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders and alternating tread devices, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal fabrications.
 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

- B. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. 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.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

METAL FABRICATIONS

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2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ~~ASTM A 36/A 36M~~ See Structural Steel of Construction Documents.
- B. Steel Tubing: ~~See Structural Steel of Construction Documents~~ ~~ASTM A 500, cold-formed steel tubing~~.

2.3 FASTENERS

- A. Anchor Bolts: ~~See Structural Steel of Construction Documents~~ ~~ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.~~
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- B. Plain Washers: Round, ASME B18.22.1.
- C. Lock Washers: Helical, spring type, ASME B18.21.1.
- D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- E. Post-Installed Anchors: Torque-controlled expansion anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain

- structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
 - C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - D. Form exposed work with accurate angles and surfaces and straight edges.
 - E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
 - G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 - H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
 - I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.

2.8 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.
- C. Prime plates with zinc-rich primer.

2.9 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of racking; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
 - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." And Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION 055000

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**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood blocking.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
1. Engineered wood products.
 2. Power-driven fasteners.
 3. Post-installed anchors.
 4. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated. See General Structural Notes for additional information.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 3. Dress lumber, S4S, unless otherwise indicated.

ROUGH CARPENTRY

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- B. Maximum Moisture Content of Lumber: See General Structural Notes.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: See General Structural Notes.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Furring.

- B. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Do not splice structural members between supports unless otherwise indicated.

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- E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 3. ICC-ES evaluation report for fastener.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preserved-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Sectional-door assemblies.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.

- 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

- B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

- 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Include diagrams for power, signal, and control wiring.

- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

- D. Samples for Initial Selection: For units with factory-applied finishes.

- 1. Include Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For manufacturer's warranty.
- C. CLOSEOUT SUBMITTALS
- D. Maintenance Data: For sectional doors to include in maintenance manuals.
- E. Manufacturer's warranty.
- F. Finish warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.
 - 2. Warranty Period (motor): 5 years from date of Substantial Completion.
- B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

SECTIONAL DOORS

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1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in constructions.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 1. Design Wind Load: As indicated on Drawings.
 2. Testing: In accordance with ASTM E330/E330M.
 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
 - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
 - b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.
- C. Windborne-Debris Impact Resistance: Provide sectional doors complying with the following requirements:
 1. Glazed Openings: Pass ASTM E1886 Large Missile Test and cyclic-pressure tests in accordance with ASTM E1996 for basic protection and Wind Zone applicable to basic design wind speed indicated on Drawings
 2. Garage-Door Glazed Openings: Pass DASMA 115.

2.3 SECTIONAL-DOOR ASSEMBLY

- A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.
 1. Manufacturers: Basis of design – Wayne Dalton TS200 or equal.
 - a. Wayne Dalton; a division of Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m) when tested in accordance with ASTM E283 or DASMA 105.
- D. U-Value: 0.120 Btu/sq. ft. x h x deg F (0.738 W/sq. m x K).
- E. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G60 (Z180) zinc coating.

1. Door-Section Thickness: 2 inches (51 mm).
 - a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
 - b. Exterior Face: Fabricated from single sheets, not more than 24 inches (610 mm) high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
 - 1) Steel Sheet Thickness: 0.016-inch (0.48-mm) nominal coated thickness.
 - 2) Surface: Manufacturer's standard, flat.
 - c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:
 - d. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
 - e. Hardware Locations: Provide reinforcement for hardware attachment.
 2. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free insulation of type indicated below:
 - a. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
 - b. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.
 3. Insulated Stiles and Rails: Fill stiles and rails manufacturer's standard polyurethane expanding foam.
 4. Glazed Panels: Manufacturer's standard, aluminum-framed section with glazing sealed with glazing tape and glazing bead. Glazing as follows:
 - a. Insulating Glass Units: Manufacturers' standard unit with tempered glass lites complying with ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (clear), Quality-Q3.
- F. Track: Manufacturer's standard, galvanized-steel, low-headroom track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 (Z180) zinc coating.
 2. Size: 3 inches (76 mm) wide.
 3. Tracks to be center hung for heights 12'+.
 4. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.
 - a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide continuous angle attached to track and wall.

- b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- G. Weather seals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top and jambs of door. Provide combination bottom weather seal and sensor edge for bottom seal.
 - 1. Insulating Glass Units: Manufacturer's standard.
- H. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
 - 1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch (2.01-mm) nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
 - a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
 - b. Provide double-end hinges where required for doors more than 16 ft. (4.88 m) wide unless otherwise recommended by door manufacturer in writing.
 - 2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
 - a. Roller-Tire Material: Manufacturer's standard.
 - 3. Push/Pull Handles: Equip each door with galvanized-steel lifting handles on each side of door, finished to match door.
- I. Locking Device:
 - 1. Chain Lock Keeper: Suitable for padlock.
- J. Counterbalance Mechanism:
 - 1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
 - 2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.
 - a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
 - b. Provide one additional midpoint bracket for shafts up to 16 ft. (4.88 m) long and two additional brackets at one-third points to support shafts more than 16 ft. (4.88 m) long unless closer spacing is recommended in writing by door manufacturer.

- 3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 7 to 1.
 - 4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
 - 5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
 - 6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.
- K. Electric Door Operator: Basis of design to be LiftMaster GT or equal.
- L. Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
- 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
 - 3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. (2.4 m) or lower.
 - 4. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
 - 5. Operator Type: Trolley with wall mounted hand chain option.
 - 6. Motor: Reversible-type for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.
 - a. Motor Size: **1/2 hp (373 W)**.
 - b. Electrical Characteristics:
 - 1) Phase: Single phase.
 - 2) Volts: 460 V.
 - 7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
 - 8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
 - a. Monitored Entrapment Protection: Nema Rated Photoelectric sensor designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
 - b. Unmonitored Entrapment Protection: Pneumatic sensor edge, black, located within weatherseal mounted to bottom bar.
 - 9. Control Station: Surface mounted, three-position (open, close, and stop) control.
 - a. Operation: Push button.

- b. Interior and Exterior Mounted Unit: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 - c. Features: Provide the following:
 - 1) Nema Rated Photocell operation.
 - 10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf (111 N).
 - 11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level.
 - 12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- M. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.
- B. Tracks:
 1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches (610 mm) apart.
 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install automatic garage doors openers in accordance with UL 325.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and application of high-performance coating systems on the following substrates:

- 1. Exterior Substrates:

- a. Steel.

- B. Related Requirements:

- 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.

1.3 DEFINITIONS

- A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- B. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

- D. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
 2. Cloverdale Paint.
 3. Columbia Paint & Coatings.
 4. ICI Paints.
 5. Kwal Paint.
 6. PPG Architectural Finishes, Inc.
 7. Sherwin-Williams Company (The).

- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."

- B. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

- C. Colors: Match Architect's samples.

2.3 METAL PRIMERS

- A. Primer, Epoxy, Anti-Corrosive, for Metal: MPI #108.

1. 1C1 Paints; Duron/Fuller, Surface Tolerant Epoxy, DP32U-XX.
2. Sherwin-Williams Company; Industrial and Marine, Macropoxy 646 Fast Cure B58W610.

2.4 POLYURETHANE COATINGS

- A. Polyurethane, Two-Component, Pigmented (Gloss Level 6): MPI #72.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

- a. Benjamin Moore & Co.; Aliphatic Acrylic Urethane Gloss, CM74/M75.
- b. Cloverdale Paint; ClovaThane, 834 Series.
- c. Columbia Paint & Coatings; Insl-x, Insl-Tron, AU-0500.
- d. General Paint, Ameron; Amercoat, 450 HS.
- e. ICI Paints; Devoe Coatings, Devthane Aliphatic Urethane, 369.
- f. PPG Architectural Finishes, Inc.; Pitthane, Urethane Aliphatic Pigmented Gloss, 95-850.
- g. Spectra-Tone; Insl-x; Insl-Tron Aliphatic Polyurethane, AU-0500 Series.
- h. Sherwin-Williams; Hi-Solids Polyurethane 100 B65W625.

2. VOC Content: Minimum E Range of E1 <100 g/L (0.83lb/gal).

2.5 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 1. Use applicators and techniques suited for coating and substrate indicated.
 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel Substrates:
 - 1. Pigmented Polyurethane over Epoxy System:
 - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #108.
 - b. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6).
 - c. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6).

END OF SECTION 099600

SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 Check for the following

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:

1. Wet-pipe sprinkler systems.
2. Description: Modification of existing wet-pipe sprinkler system to accommodate replacement of a coiling door with an overhead door.

- B. Related Sections include the following:

1. Division 10 Section "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.
 2. Division 22 Section "Facility Water Distribution Piping" for piping outside the building.
 3. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.
- C. All black steel sprinkler pipe shall have a wall thickness less than or equal to schedule 40 and greater than schedule 10.

- D. Summary Table:

Item	Summary	ref
Interior pipe type	Threadable thinwall or schedule 40	2.3.2.
Sprinkler Finish	Flat Plate Concealed, except uprights and storage	3.11,3.12
Extended Coverage	Allowed	3.11.A
Flexible Sprinkler Drops	Designer's preference	2.9
Calculations	Not required	1.5.D,3.1

1.4 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.

- C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.
- D. PE: Polyethylene plastic.
- E. Underground Service-Entrance Piping: Underground service piping below the building.

1.5 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.6 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Design sprinkler piping according to the following and obtain approval from engineer, prior to submitting to other authorities having jurisdiction:
 1. Design sprinkler system with the 10% reduced flow data using flow data location, static pressure, residual pressure, flow rate, date of test, and persons performing test provided by contractor.
 2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 3. Sprinkler Occupancy Hazard Classifications:
 - a. Automobile Parking Areas: Ordinary Hazard, Group 1.
 - b. Building Service Areas: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 4. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 5. Maximum Protection Area per Sprinkler: Per UL listing.
 - a. Storage Areas: 130 sq. ft..
 - b. Mechanical Equipment Rooms: 130 sq. ft..
 - c. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:

- a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
- b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
- C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

1.7 SUBMITTALS

- A. Product Data: For the following:
 - 1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
 - 2. Pipe hangers and supports, including seismic restraints.
 - 3. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Fire-hydrant flow test report.
- D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction. Drawings are to be approved by Engineer prior to submission to State Fire Marshal.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- F. Welding certificates.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction. The Engineer requires evidence to support the ability of the contractor to perform work in the scope and volume as specified. A contractor, who cannot show such experience, may be found not suitable to perform the work.
 - B. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility.

1. Engineering Responsibility: Preparation of working plans, and field test reports by a qualified professional engineer or NICET Level III technician.
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 1. NFPA 13, "Installation of Sprinkler Systems."
 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
- E. International Conference of Building Code Officials codes and standards complying with the following:
 1. IBC-2015, "International Building Code."
 2. IFC-2015, "International Fire Code."
- F. Utah Amendments
 1. Title 15A

1.9 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

1.11 General Engineering Quality

- A. Unless noted otherwise the following applies:
 1. The maximum water velocity shall not exceed 32-fps.
 2. In the event of multiple (3) submittal rejections (including revise and resubmit) a meeting shall be held at the engineer's office at the engineer time of choosing and the designer, fire sprinkler contractor, and general contractor shall be physically in attendance to discuss the required modifications to the design.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, Class 53, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.

2.3 C-900 TUBE AND FITTINGS

2.4 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
1. Cast-Iron Threaded Flanges: ASME B16.1.
 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
 5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.

1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.
- C. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.
 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- D. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, roll-grooved ends.
 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Central Sprinkler Corp.
 - 3) Victaulic Co. of America.
 - 4) Ward Manufacturing.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
 - E. Threaded-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed threaded ends.
 1. Cast-Iron Threaded Flanges: ASME B16.1.
 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe.
 5. Steel Threaded Couplings: ASTM A 865.
 - F. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10.
 1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.
 - G. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10.
 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.

H. Grooved-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed, roll-grooved ends.

1. Grooved-Joint Piping Systems:

a. Manufacturers:

- 1) Anvil International, Inc.
- 2) Central Sprinkler Corp.
- 3) Victaulic Co. of America.
- 4) Ward Manufacturing.

- b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
- c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

I. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 is not allowed.

J. Plain-End, Nonstandard OD, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 10 is not allowed.

K. Plain-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5 is not allowed.

L. Grooved-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5; with factory- or field-formed, roll-grooved ends are not allowed.

M. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with plain ends is not allowed.

2.5 CPVC TUBE AND FITTINGS

A. CPVC shall be permitted where installed in accordance with its listing limitations, including installation instructions.

B. Specially Listed Fittings Materials and Dimensions

1. Schedule 80 CPVC Threaded fittings: ASTM F 437.
2. Schedule 40 CPVC Socket-type fittings: ASTM F 438.
3. Schedule 80 CPVC Socket-type fittings: ASTM F 439.

2.6 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper; with plain ends.

1. Copper fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 2. Brazing Filler Metals: AWS A5.8, BCuP-3 or BCuP-4.
- B. Plain-End, Hard Copper Tube: ASTM B 88, Type K or ASTM B 88, Type L, water tube, drawn temper.
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match tubing system.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket metal-to-metal seating surfaces, and solder-joint or threaded ends.
 4. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube not allowed.
 5. Brazing Filler Metals: AWS A5.8, BCuP-3 or BCuP-4.
- C. Grooved-End, Hard Copper Tube: ASTM B 88, Type K or ASTM B 88, Type L, water tube, drawn temper; with factory- or field-formed, roll-grooved ends.
1. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube not allowed.
 2. Grooved-Joint Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Victaulic Co. of America.
 - b. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting. Fittings may have ends factory or field expanded to steel-pipe OD if required for copper tube systems using grooved-end-pipe couplings.
 - c. Grooved-End-Tube Couplings: UL 213, rigid pattern, unless otherwise indicated; gasketed fitting equivalent to AWWA C606, but made to match copper-tube OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts. Use grooved-end-pipe couplings for tube and fitting that have expanded ends.

2.7 DIELECTRIC FITTINGS

- A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.
- B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.
1. Manufacturers:
 - a. Capitol Manufacturing Co.

- b. Central Plastics Company.
 - c. Epcos Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Industries, Inc.; Wilkins Div.
- C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.
1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epcos Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- D. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
 - a. Advance Products and Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Insert manufacturer's name.
- E. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225 deg F.
1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- F. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225 deg F.
1. Manufacturers:
 - a. Perfection Corporation.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Co. of America.

2.8 FLEXIBLE SPRINKLER DROPS

- A. Flexible connectors shall be FM approved with exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:

1. NPS 1: Threaded.
- B. Manufacturers:
1. Flex-Head
 2. Victaulic
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.9 FLEXIBLE PIPE CONNECTORS (SEISMIC)

- A. Flexible connectors shall be FM approved with exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
1. NPS 2 and Smaller: Threaded.
 2. NPS 2-1/2 and Larger: Flanged.
 3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.
- B. Manufacturers:
1. Flexicraft Industries.
 2. Flex-Pression, Ltd.
 3. Metraflex, Inc.
- C. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.
- D. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- E. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.10 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be FMG approved with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 250-psig minimum working-pressure rating if fittings are components of high-pressure piping systems.

- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body, with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
1. Manufactures:
 - a. Central Sprinkler Corp.
 - b. Fire-End and Croker Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

2.11 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 250-psig minimum 300-psig pressure rating if sprinklers are components of high-pressure piping system.
- B. Sprinklers shall have 250-psig minimum 300-psig pressure rating if sprinklers are components of high-pressure piping system.
- C. Manufacturers:
 1. Central Sprinkler Corp.
 2. Globe Fire Sprinkler Corporation.
 3. Grinnell Fire Protection.
 4. Reliable Automatic Sprinkler Co., Inc.
 5. Star Sprinkler Inc.
 6. Victaulic Co. of America.
 7. Viking Corp.
 8. Tyco Fire
- D. Automatic Sprinklers: With heat-responsive element complying with the following:
 1. UL 199, for nonresidential applications.
- E. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
 1. Open Sprinklers: UL 199, without heat-responsive element.
 - a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
 - b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.

F. Sprinkler types, features, and options as follows:

1. Flow-control sprinklers, with automatic open and shutoff feature.
2. Flush ceiling sprinklers, including escutcheon, not allowed.
3. Institution sprinklers, made with a small, breakaway projection.
4. Quick-response sprinklers.
5. Sidewall sprinklers.
6. Upright sprinklers.

G. Sprinkler Finishes: Chrome plated, bronze, and painted. Finishes as approved by FM Global.

H. Special Coatings: Wax, lead, and corrosion-resistant paint.

I. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Flat plate concealed, white.
2. Sidewall Mounting: Semi-Recessed, white.

J. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PIPING APPLICATIONS

A. Shop weld pipe joints where welded piping is indicated.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

D. Sprinkler Main Piping: Use the following:

1. NPS 6 and Smaller: Standard-weight steel pipe with threaded ends, or grooved ends. No plain ends allowed.
2. Outlets shall be welded.
 - a. Victaulic Brand Mechanical tee fittings may be used in lieu of welded outlets.

E. Branch line piping: Use the following:

1. NPS 2 and Smaller: Threadable steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.
 - a. Victaulic Brand Mechanical tee fittings may be used

3.4 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping joint construction.
- B. Ductile-Iron-Piping, Grooved Joints: Use ductile-iron pipe with radius-cut-grooved ends; ductile-iron, grooved-end fittings; and ductile-iron, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
- C. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.

3.5 PIPING INSTALLATION

- A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping.
 - 1. No powder driven studs allowed.
 - 2. Wrap-around braces are to be provided at end of branch lines.
- I. Earthquake Protection: Install piping according to NFPA 13-9.3 requirements, to protect from earthquake damage. Seismic Bracing shall be designed to withstand vertical forces and movement.
- J. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated, or required by NFPA 13 for flexibility in seismic zones.

3.6 SPECIALTY SPRINKLER FITTING INSTALLATION

- A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.7 SPRINKLER APPLICATIONS

- A. General: All sprinklers are to be quick response type. Sprinkler heads shall be of the latest design closed spray type for 155°F unless specified otherwise or required by code. Extended coverage heads shall not be used. Orifices larger than 1/2" may be used as required by density and spacing demands. Use sprinklers according to the following applications:
 - 1. Rooms without Ceilings: Upright and/or pendent sprinklers. Provide mechanical guards on all heads at or below 7'-0" height above the floor or where damage from room occupant use may occur.
 - 2. Wall Mounting: Sidewall sprinklers with recessed escutcheon.
 - 3. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
 - 4. Provide freeze proof type automatic sprinkler heads serving unconditioned spaces, areas subject to freezing and in other areas requiring their use.
 - 5. Heads located within the air streams of unit heaters or other heat-emitting equipment shall be selected for proper temperature rating.
 - 6. Sprinkler Finishes: Use sprinklers with the following finishes:

- a. Upright, Pendent, and Sidewall Sprinklers: Chrome in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.
 - b. Concealed Sprinklers: Rough brass, with White cover plate to match ceiling color.
 - c. Semi-Recessed Sprinklers: White, with FMG approved white escutcheon.
- B. Sprinklers: Use the following:
- 1. All sprinklers shall be listed, quick response type.
 - 2. Sprinkler in future finish spaces (shelled) 10' x 10' spacing shall be pendants/uprights installed with 1 x 1/2" bushing, to accommodate future finishes.
 - 3. Finish ceiling spaces shall have semi-recessed type escutcheon.

3.8 SPRINKLER INSTALLATION

- A. Every effort shall be required to insure that the heads form a symmetrical pattern in the ceiling with the ceiling grid, lights, diffusers and grilles. Offsets shall be made in piping to accommodate ductwork in the ceiling. Heads should be symmetrical and all piping run parallel or perpendicular to building lines.
 - 1. In no case shall sprinkler heads be installed closer than approved distances from ceiling obstructions and HVAC ductwork.
 - 2. Sprinkler heads shall not conflict with tile grids.
 - 3. Sprinkler heads shall be located near center of corridors.
- B. Where layout of sprinkler heads is shown on reflected ceiling plans the locations shall be followed unless approval is obtained from the Architect or such locations shown do not meet the requirements of NFPA-13. In either case, approval of the Architect shall be obtained in writing before sprinkler head locations are changed. If the installation of additional heads is needed to conform to NFPA 13 requirements in areas where heads are shown on reflected ceiling plans, they shall be included in the contract price.
- C. Install sprinklers in patterns indicated.
- D. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.9 CONNECTIONS

- A. Connect water-supply piping and sprinklers where indicated.

3.10 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Division 23 Section "Common Work Result for HVAC."

3.11 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. When making a mechanical tee connection the coupon shall be attached at the mechanical tee.
- D. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- E. Whether the underground serving the sprinkler system is done by this contractor or another, this contractor will be responsible to assure and have in his possession a certificate that the underground has been flushed and tested by the contractor who installed it in accordance with NFPA-24 prior to connection of the underground piping to the overhead sprinkler system.

3.12 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers having paint other than factory finish.

3.13 PROTECTION

- A. Protect sprinklers from damage until Substantial Completion.

3.14 COMMISSIONING

- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- B. Verify that specified tests of piping are complete and that "Material Test Certificates" are complete.
- C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- E. Fill wet-pipe sprinkler piping with water.
- F. Coordinate with fire alarm tests. Operate as required.

3.15 DEMONSTRATION & TESTS

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. All tests will be conducted as required by the local authority having jurisdiction, and in no case less than those required by NFPA standards. As a minimum, piping in the sprinkler system shall be tested at a water pressure at 200 psi for a period of not less two hours, or at 50 psi in excess of the normal pressure when the normal pressure is above 150 psi. Bracing shall be in place, and air shall be removed from the system through the hydrants and drain valves before the test pressure is applied. No apparent leaks will be permitted on interior or underground piping.
- C. The local jurisdiction having authority and the Utah State Fire Marshal's office (where required) shall be notified at least three working days in advance of all tests and flushing. This includes any flushing of underground, hydrostatic testing, or flow testing that may be required.
- D. This contractor shall make all the required tests to the sprinkler system as required by code. He shall be responsible to assure that the Contractor Test Certificates for the overhead, backflow and underground work are completed and delivered to the owner's insurance underwriter to assure proper insurance credit.
- E. All tests requiring the witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness, then they will be run later and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this contractor.

3.16 WARRANTY

- A. This contractor shall warranty the sprinkler system and all its components for one year from the date of acceptance by the owner. Any costs incurred to extend any warranties of materials to assure this time frame shall be borne by this contractor.
- B. Provide Operation and Maintenance Manuals with correct as-builts test certificates and warranties included. A minimum 6 sets to be provided in red 3-ring binders. Include a current adopted version of NFPA 25 softbound copy left with owner.
- C. Electronic copy of AutoCAD as-built drawings shall also be provided on CD, with each O&M Manual.

3.17 FIELD QUALITY CONTROL

- A. Flush, test and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

END OF SECTION 211000

WATER BASED FIRE SUPPRESSION SYSTEMS

211000 - 18

**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

SECTION 230100 - MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. The General Conditions of the Contract, with the amendments, supplements, forms and requirements in Division 1, and herewith made a part of this Division.
- B. All sections of Division 21, 22, & 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.
- C. Mechanical equipment that is pre-purchased if any will be assigned to the Mechanical Contractor. By assignment to the Mechanical Contractor, the Mechanical Contractor shall accept and installed the equipment and provide all warranties and guarantees as if the Mechanical Contractor had purchased the equipment.
- D. Construction Indoor-Air Quality Management
 - 1. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
 - a. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 - b. Replace all air filters immediately prior to occupancy.
- E. No HVAC equipment is to be installed without seismic bracing submittal stamped by a structural engineer licensed in the State of Utah and approved by the design team and the City. The deferred seismic submittal is required to be kept on the construction site as part of the Permit Set for building inspector's use.

1.2 SCOPE OF WORK

- A. The project described herein is the SLCIA Relocated Vehicle Gates 10 & 11. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.

1.3 CODES & ORDINANCES

- A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and Specifications be required to comply with these regulations, the Contractor shall notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all

work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.

B. Applicable current codes:

1. International Building Code
2. International Mechanical Code
3. International Plumbing Code
4. International Fire Code
5. International Energy Code
6. International Fuel Gas Code

1.4 INDUSTRY STANDARDS

A. All work shall comply with the following standards.

1. Associated Air Balance council (AABC)
2. Air Conditioning and Refrigeration Institute (ARI)
3. Air Diffusion council (ADC)
4. Air Movement and Control Association (AMCA)
5. American Gas Association (AGA)
6. American National Standards Institute (ANSI)
7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing Materials (ASTM)
10. American Water Works Association (AWWA)
11. ETL Testing Laboratories (ETL)
12. Institute of Electrical and Electronic Engineers (IEEE)
13. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
14. National Fire Protection Association (NFPA)
15. National Electrical Code (NEC)
16. National Electrical Manufacturers Association (NEMA)
17. National Electrical Safety code (NESC)
18. Utah safety Standard (OSHA), Utah State Industrial Council.
19. Sheet Metal and Air Conditioning Contractor=s National Association (SMACNA)
20. Underwriters Laboratories (UL)
21. Thermal Insulation Manufacturer=s Association (TIMA)
22. Scientific Apparatus Makers Association (SAMA)

B. Compliance Verification:

1. All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
2. Form U-1, the manufacturer=s data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
3. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

1.5 UTILITIES & FEES

- A. All fees for permits required by this work will be paid by this division. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or installed by this Contractor, shall be complete with all utilities, components, commodities and accessories required for a fully functioning system. This Contractor shall furnish smoke generators when required for testing, furnish glycol for glycol piping systems, full load of salt to fill brine tank for water softening system, furnish cleaners and water treatment additives.

1.6 SUBMITTALS AND SHOP DRAWINGS

- A. Submittals: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect six (6) copies of the descriptive literature covering products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of 14 days. The first day starts after the day they are received in the engineers office to which the project is being constructed from. If the Contractors schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within 14 days of returned submittals. Refer to each specification section for items requiring submittal review. Written approval of the Owner's Representative shall be obtained before installing any such equipment or materials for the project. The submittals shall be prepared in an orderly manner, contained in a 3-ring loose-leaf binder with index and identification tabs each item or group of items and for each specification section. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within 120 days of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.
- B. Submitted literature shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.
- C. Submitted literature shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.
- D. Submitted literature shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.
- E. Review by the Owner's Representative is for general conformance of the submitted equipment to the project specification. In no way does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. Regardless of any items overlooked by the submittal review, the requirements of the contract drawings and specifications must be followed and are not waived or superseded in any way by the review.

- F. By description, catalog number, and manufacturer's names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.
- G. If the Engineer is required to do additional design work to incorporate changes caused by submitting equipment or products, different than the design equipment specified, as defined above, the contractor shall reimburse the engineer for additional time and expenses at the engineer's current, recognized, hourly rates.

1.7 DRAWINGS AND MEASUREMENTS

- A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.
- B. It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect's office before work is started.
- C. This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time during the construction process, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.
- D. The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.
- E. The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.
- F. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or work of other trades. The drawings shall be a minimum scale of 1/4 inch= 1 foot and of such detail as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.
- G. Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will show all ductwork in the entire building and shall be coordinated with architectural, structural

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and electrical portions of the project. The contractor shall specifically obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

1.8 CONTRACTOR'S USE OF BUILDING EQUIPMENT

- A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

1.9 EXISTING CONDITIONS

- A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for an extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.
- B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.
- C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.

1.10 EQUIPMENT CAPACITIES

- A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate that has capacities or performance less than that of design equipment.

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- B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers' standard ratings shall be adjusted accordingly. All capacities and performances listed on drawings or in specifications are for job-site conditions.

1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT

- A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic snubbers and/or seismic anchors.

1.12 COOPERATION WITH OTHER TRADES

- A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.
- B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.
- C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.
- D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110-16 and 384-4 of the National Electrical Code relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.

1.13 RESPONSIBILITY OF CONTRACTOR

- A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner's Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.
- B. If a conflict arises between the drawings and the specifications the most stringent procedure/action shall be followed. A clarification to the engineer will help to determine the course of action to be taken. If a conflict arises between specification sections the engineer will determine which course of action is to be followed.

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1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES

- A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.
- B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

1.15 UNFIT OR DAMAGED WORK

- A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

1.16 WORKMANSHIP

- A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative. Nothing contained herein shall relieve the Contractor from making good and perfect work in all details in construction.

1.17 SAFETY REGULATION

- A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.18 ELECTRICAL SERVICES

- A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division unless shown to be furnished by Division 26. All such wiring shall be in conduit as required by electrical codes. Wiring in the mechanical rooms, fans rooms and inaccessible ceilings and walls shall be installed in conduit as well. Installation of any and all wiring done under Division 21, 22 and 23 shall be in accordance with the requirements of Division 26, Electrical.
- B. All equipment that requires an electrical connection shall be furnished so that it will operate properly and deliver full capacity on the electrical service available.

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- C. Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.
- D. The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT

- A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.
- B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.
- C. The Execution portions of the specifications specify what products and materials may be used. Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.
- D. The access to equipment shown on the drawings is the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.
- E. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.
- F. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS

- A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor's expense.
- B. All open duct and pipe openings shall be adequately covered at all times.

1.21 INSTALLATION CHECK

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.
- B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.
- C. All costs for this work shall be included in the prices quoted by equipment suppliers.

1.22 EQUIPMENT LUBRICATION

- A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.
- B. Necessary time shall be spent with the Owner's Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.
- C. Detergent oil as used for automotive purposes shall not be used for this work.

1.23 CUTTING AND PATCHING

- A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.
- B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

1.24 ACCESS

- A. Provide access doors in walls, ceilings and floors by this division unless otherwise noted. For access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation. If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR

Smith No. 4760 bonderized and painted. Doors in tile walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910

- B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.
- C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.
- D. It is the responsibility of this division to install terminal boxes, valves and all other equipment and devices so they can be accessed. If any equipment or devices are installed so they cannot be accessed on a ladder a catwalk and ladder system shall be installed above the ceiling to access and service this equipment.

1.25 CLEANING AND PAINTING

- A. Cleaning: After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.
- B. Painting: Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 9, Painting.
- C. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.
- D. Removal of Debris, Etc: Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

1.26 CONTRACT COMPLETION

- A. Incomplete and Unacceptable Work: If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.

- B. Maintenance Instructions: The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.
- C. Instructions To Owner's Representatives: In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to train the Owner's representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not be reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.
- D. Guarantee: By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.
- E. The guarantee so assumed by the Contractor and as work of this Section is as follows:
 - 1. That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.
 - 2. That the circulation of water shall be complete and even.
 - 3. That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.
 - 4. That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.
 - 5. That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.
 - 6. All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect's Certificate of Substantial Completion.
 - 7. All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.

8. If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

1.27 TEST RUN

- A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

1.28 EQUIPMENT STARTUP AND CHECKOUT:

- A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.
- B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

END OF SECTION 230100

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.
12. Link-Seal

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 1. CPVC: Chlorinated polyvinyl chloride plastic.

2. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.
 - 2.

2.5 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Watts Industries, Inc.; Water Products Div

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 LINK-SEAL MODULAR SEAL PRESSURE PLATES

- A. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
 - 1. Izod Impact - Notched = 2.05ft-lb/in. per ASTM D-256
 - 2. Flexural Strength @ Yield = 30,750 psi per ASTM D-790
 - 3. Flexural Modulus = 1,124,000 psi per ASTM D-790
 - 4. Elongation Break = 11.07% per ASTM D-638
 - 5. Specific Gravity = 1.38 per ASTM D-792
- B. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a “Hex Nut Interlock” designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer’s name molded into it.
- C. For fire service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.
- D. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be:
 - 1. 316 Stainless Steel per ASTM F593-95, with a 85,000 psi average tensile strength.
 - 2.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

COMMON WORK RESULT FOR HVAC

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- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.8 LINK SEAL

- A. Provide Link Seal at all piping penetrations from the outside.

COMMON WORK RESULT FOR HVAC

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END OF SECTION 230500

B L A N K P A G E

COMMON WORK RESULT FOR HVAC

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**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

SECTION 23 0523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze lift check valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron globe valves.
7. Lubricated plug valves.

- B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.03 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated. Body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list of GENERAL DUTY VALVES FOR HVAC PIPING

indicating valve and its application.

- B. Maintenance data for valves to be included in the operation and maintenance data specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.05 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve as listed in SUMMARY from a single source and from a single manufacturer.
- B. Compliance:
 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 2. ASME B31.1 for power piping valves.
 3. ASME B31.9 for building services piping valves.
 4. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, and weld ends.
 3. Set angle, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inchstem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
 - a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg. For, globe, and check valves: below 421 deg. F for ball valves.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. APCO Willamette Valve and Primer Corp.
2. Babbitt Steam Specialty Company. Chainwheels.
3. Bray Controls.
4. Center Line.
5. Cla-Val Company.
6. Conbraco Industries Inc.
7. Crane Co.; Crane Valve Group.
8. Flo Fab Inc.
9. Flow-Tek Inc.
10. Grinnell Corporation.
11. Hammond Valve.
12. Keystone Valve USA, Inc.
13. Kitz Corp.
14. Metraflex Company.
15. Milwaukee Valve Company.
16. NIBCO Inc.
17. Red-White Valve Corp.
18. Stockham Valves and Fittings, Inc.
19. Tyco Fire/Shurjoint Piping Products.

20. Tyco/Pentair LTD.
21. Val-Matic Valve & Mfg. Corp.
22. Victaulic Company.
23. Watts Regulator Company.

2.03 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.04 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 150 CWP, Iron, Single-Flange (Lug) Butterfly Valves:

1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nylon 11 coated ductile iron.

- B. 175 CWP, Iron, Single-Flange (Lug) Butterfly Valves:

1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nylon 11 coated ductile iron.

- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Nylon 11 coated ductile Iron Disc:

1. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nylon 11 coated ductile iron.

2.05 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valve:

1. Description:

- a. Standard: MSS SP-80.
- b. CWP Rating: 200 psig.
- c. Body Design: Vertical flow.
- d. Body Material: ASTM B 61, ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze, Type 1.

2.06 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.07 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

2.08 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 300 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Teflon impregnated, asbestos free.
- h. Handwheel: Malleable iron.

2.09 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Description:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Stem: Brass alloy. OS &Y.
- f. Disc: Renewable bronze seat.
- g. Trim: Bronze.
- h. Packing and Gasket: Teflon impregnated, asbestos free.
- i. Handwheel: Cast iron

2.10 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Description:

- a. Standard: MSS SP-78, Type II.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. Pattern: Regular or short.
- d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
- e. Plug: Cast iron or bronze with sealant groove.

2.11 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.

2. Attachment: For connection to butterfly valve stems.

3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine piping system for compliance³ with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above center of pipe.
- F. Install valves in position to allow full stem movement.
- G. Install chainwheels on operators for ball, butterfly globe and plug valves NPS 4 and larger and more than 96 inches above floor.
- H. Extend the chainwheels for chains to 60 inches above finished floor or otherwise directed by owner.
- I. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.
4. Install all check valves a minimum of five pipe diameters downstream of pump discharge or elbow to avoid flow turbulence. In extreme cases add flow straighteners as required to correct the turbulence.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball or butterfly valves.
 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 3. Throttling Service except Steam: Globe valves.
 4. Throttling Service, Steam: Globe valves.
 5. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or ironmetal-seat check valves.
 6. Drain Service (except Steam): Two-Piece, Full Port Bronze Ball Valves with Bronze Trim. To be installed with NPS $\frac{3}{4}$ hose thread outlet and hose cap with chain.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves:
 - a. Piece: Two

- b. Port: Full.
 - c. Material/Trim: Bronze with:
 - 1) Bronze trim.
 - 3. Bronze Swing Check Valves:
 - a. Class 150
 - b. Bronze disc.
 - 4. Bronze Globe Valves:
 - a. Class 125
 - b. Bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
 - a. 200 CWP,
 - b. Seat: EPDM.
 - c. Disc: Ductile-iron.
 3. Iron Swing Check Valves: Class 125, metal seats.
 4. Iron Globe Valves: Class 125.
 5. Lubricated Plug Valves: Class 125, regular gland, flanged.

3.06 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves:
 - a. Piece: Two
 - b. Port: Full.
 - c. Material/Trim: Bronze with:
 - 1) Bronze trim.
 3. Bronze Swing Check Valves:
 - a. Class 150
 - b. Bronze disc.
 4. Bronze Globe Valves:
 - a. Class 125
 - b. Bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
 - a. 200 CWP,
 - b. Seat: EPDM.
 - c. Disc: Ductile-iron.
 3. Iron Swing Check Valves: Class 125, metal seats.
 4. Iron Globe Valves: Class 125.

END OF SECTION

SECTION 230529 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 1. Steel pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Metal framing systems.
- B. Related Sections include the following:
 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
 3. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Mechanical Anchors: ICC-ES Evaluation Reports validating 'Cracked Concrete' testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel." ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.

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7. Globe Pipe Hanger Products, Inc.
 8. Grinnell Corp.
 9. GS Metals Corp.
 10. National Pipe Hanger Corporation.
 11. PHD Manufacturing, Inc.
 12. PHS Industries, Inc.
 13. Piping Technology & Products, Inc.
 14. Tolco Inc.
 15. Simpson Strong-Tie Co.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. Hilti, Inc.
 4. GS Metals Corp.
 5. Power-Strut Div.; Tyco International, Ltd.
 6. Thomas & Betts Corporation.
 7. Tolco Inc.
 8. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18 or Simpson Blue Banger Concrete insert with UL & FM approvals): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to

- flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use mechanical-expansion anchors or screw instead of building attachments where required in

concrete construction. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for ‘Cracked Concrete’ per A.C. 193 and shall have a valid ICC-ES Evaluation Report

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying. For applications where seismic bracing is required, ‘Cracked Concrete’ expansion anchors or concrete screws tested per A.C. 193 must be provided for seismic bracing anchorage where post-installed anchors are required.
- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- H. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- J. Insulated Piping: Comply with the following:
 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through

- insulation.
- b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
- c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
- 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood inserts.
- 6. Insert Material: Length at least as long as protective shield.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply

with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

B L A N K P A G E

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE

- A. Provide engineered vibration isolation and restraint systems in accordance with the requirements of this section including design, engineering, materials, testing, inspections and reports.
- B. Mechanical equipment with moving parts shall be mounted on or suspended from vibration isolators to reduce the transmission of vibration and mechanically transmitted sound to the building structure.
- C. Piping and ductwork in mechanical rooms shall be mounted on or suspended from vibration isolators to reduce the transmission of vibration and mechanically transmitted sound to the building structure.
- D. All mechanical equipment, piping and ductwork shall be restrained as required by Federal, State and Local building codes to preserve the integrity of nonstructural building components during seismic events to minimize hazards to occupants and reduce property damage.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Open-spring isolators.
 - 5. Housed-spring isolators.
 - 6. Restrained-spring isolators.
 - 7. Housed-restrained-spring isolators.
 - 8. Pipe-riser resilient supports.
 - 9. Resilient pipe guides.
 - 10. Air-spring isolators.
 - 11. Restrained-air-spring isolators.
 - 12. Elastomeric hangers.
 - 13. Spring hangers.
 - 14. Snubbers.
 - 15. Restraint channel bracings.

- 16. Restraint cables.
 - 17. Seismic-restraint accessories.
 - 18. Mechanical anchor bolts.
 - 19. Adhesive anchor bolts.
 - 20. Vibration isolation equipment bases.
 - 21. Restrained isolation roof-curb rails.
 - 22. Certification of seismic restraint designs.
 - 23. Installation supervision.
 - 24. Design of attachment of housekeeping pads.
 - 25. All components requiring IBC compliance and certification.
 - 26. All inspection and test procedures for components requiring IBC compliance.
 - 27. Restraint of all mechanical equipment, pipe and ductwork, within, on, or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.
 - 28. Seismic certification of equipment
- B. Related Requirements:
- 1. Section 21 0548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
 - 2. Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.

1.4 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. ASCE: American Society of Civil Engineers
- D. OSHPD: Office of Statewide Health Planning and Development for the State of California.
- E. Ip: Importance Factor.
- F. ESSENTIAL FACILITIES, (Occupancy Category IV, IBC-2006)
 - 1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.
- G. LIFE SAFETY
 - 1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels.
 - 2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment, including all lighting, generators, transfer switches and transformers.
 - 3. All medical and life support systems.
 - 4. Hospital heating systems and air conditioning systems for maintaining normal ambient temperature.

5. Automated supply, exhaust, fresh air and relief air systems on emergency control sequence, including air handlers, duct, dampers, etc., or manually-operated systems used for smoke evacuation, purge or fresh air relief by the fire department.
6. Heating systems in any facility with Occupancy Category IV, IBC-2009 where the ambient temperature can fall below 32 degrees Fahrenheit.

H. HIGH HAZARD

1. All gases or fluids that must be contained in a closed system which are flammable or combustible. Any gas that poses a health hazard if released into the environment and vented Fuel Cells.

1.5 REFERENCE CODES AND STANDARDS

- A. Codes and Standards: The following shall apply and conform to good engineering practices unless otherwise directed by the Federal, State or Local authorities having jurisdiction.
 1. IBC
 2. ASCE 7
 3. NFPA 13 (National Fire Protection Association)
- B. The following guides may be used for supplemental information on typical seismic installation practices. Where a conflict exists between the guides and these construction documents, the construction documents will preside.
 1. FEMA (Federal Emergency Management Agency) manuals 412, Installing Seismic Restraints for Mechanical Equipment and 414, Installing Seismic Restraints for Ductwork and Pipe.
 2. SMACNA (Sheet Metal and Air-conditioning Contractors' National Association) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd ed.
 3. ASHRAE (American Society for Heating, Refrigerating and Air-conditioning Engineers) A Practical Guide to Seismic Restraint
 4. MSS (Manufacturers Standardization Society of the Valve and Fittings Industry) MSS SP-127, Bracing for Piping Systems, Seismic – Wind – Dynamic, Design, Selection, Application.

1.6 ISOLATOR AND RESTRAINT MANUFACTURER'S RESPONSIBILITIES:

- A. Provide project specific vibration isolation and seismic restraint design prepared by a registered design professional in the state where the project is being constructed, and manufacturer certifications that the components are seismically qualified.
 1. Provide calculations to determine restraint loads resulting from seismic forces as required by IBC, Chapter 16 and ASCE 7, latest editions. Seismic calculations shall be certified by an engineer licensed in the state where the project is being constructed.
- B. Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.
 1. Provide seismic restraint details with specific information relating to the materials, type, size, and locations of anchorages; materials used for bracing; attachment requirements of bracing to structure and component; and locations of transverse and longitudinal sway bracing and rod stiffeners.

2. Provide seismic bracing layout drawings indicating the location of all seismic restraints.
 - a. Each piece of rotating isolated equipment shall be tagged to clearly identify quantity and size of vibration isolators and seismic restraints.
- C. Provide, in writing, the special inspection requirements for all Designated Seismic Systems as indicated in Chapter 17 of the IBC.
- D. Provide training for installation, operation and maintenance of isolation and restraint systems.

1.7 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 1. Site Class as Defined in the IBC: Per the structural drawings and specifications.
 2. Assigned Occupancy Category as Defined in the IBC: Per the structural drawings and specifications.
 - a. Component Importance Factor: 1.5.
 - 1) Life safety components required to function after an earthquake.
 - 2) Components containing hazardous or flammable materials in quantities that exceed the exempted amounts for an open system listed in Chapter 4.
 - 3) For structures in Seismic Use Group IV, components needed for continued operation of the facility or whose failure could impair the continued operation of the facility.
 - 4) Storage racks in occupancies open to the general public (e.g., warehouse retail stores).
 - b. Component Importance Factor: 1.0.
 - 1) All other components
 - c. Component Response Modification Factor: Per the structural drawings and specifications.
 - d. Component Amplification Factor: Per the structural drawings and specifications.
 3. Design Spectral Response Acceleration at Short Periods: Per the structural drawings and specifications.
 4. Design Spectral Response Acceleration at 1-Second Period: Per the structural drawings and specifications.

1.8 ACTION SUBMITTALS

- A. Product Data: For the following:
 1. Submittals shall include catalog cut sheets and installation instructions for each type of anchor and seismic restraint used on equipment or components being isolated and/or restrained.
 2. Submittals for mountings and hangers incorporating springs shall include spring diameter and free height, rated load, rated deflection, and overload capacity for each vibration isolation device.
 3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES

- b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 4. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
- 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1. “Basis for Design” report: Statement from the registered design professional that the design complies with the requirements of the ASCE 7-05 Chapter 13, IBC 2009 chapter 1912 and ACI 318. In addition, the basis for compliance must also be noted, as listed below:
 - a. Project specific design documentation prepared and submitted by a registered design professional (ASCE 7, 13.2.1.1)
 - b. Submittal of the manufacturer’s certification that the isolation equipment is seismically qualified by:
 - c. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
 - d. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
 - e. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
 - 2. Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer. Copies of testing and calculations must be submitted as part of submittal documents. OSHPD pre-approved restraint systems are exempt from this requirement if their pre-approval is current and based upon the IBC 2009 (i.e. OPA-07 pre-approval numbers).
 - 3. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 4. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
 - 5. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

6. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
7. Seismic Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.9 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
 1. Submittal drawings and calculations must be stamped by a registered professional engineer in the State where the project is being constructed who is responsible for the seismic restraint design.
 2. Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data. [performed by an independent agency.]
- E. Field quality-control test reports.

1.10 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Project Architect or Engineer of Record is to provide a "Statement of Special Inspections" in conformance with 2009 IBC, Chapter 17.
- F. Each contractor responsible for the installation of Designated Seismic Systems (systems with component $Ip > 1.0$) must submit a written "Statement of Responsibility" as required by Section 17 06.1 of the IBC 2009, prior to the commencement of work on any system or component. The contractor shall:

1.11 SEISMIC CERTIFICATION OF EQUIPMENT

- A. Component Importance Factor. All plumbing and mechanical components shall be assigned a component importance factor. The component importance factor, Ip , shall be taken as 1.5 if any of the following conditions apply:
 - 1. The component is required to function for life-safety purposes after an earthquake.
 - 2. The component contains hazardous materials.
 - 3. The component is in or attached to an Occupancy Category IV structure and its failure could impair the continued operation of the facility.
- B. All other components shall be assigned a component importance factor, Ip , equal to 1.0.
- C. For equipment or components where $Ip = 1.0$.
 - 1. Submit manufacturer's certification that the equipment is seismically qualified by:
 - a. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
 - b. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
 - c. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
 - 2. The equipment and components listed below are considered rugged and shall not require Special Seismic Certification:
 - a. Valves (not in cast-iron housings, except for ductile cast iron).
 - b. Pneumatic operators.
 - c. Hydraulic operators.
 - d. Motors and motor operators.
 - e. Horizontal and vertical pumps (including vacuum pumps).
 - f. Air compressors

- g. Refrigerators and freezers.
 - h. Elevator cabs.
 - i. Underground tanks.
 - j. Equipment and components weighing not more than 20 lbs. supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with Chapter 13, ASCE 7.
 - 3. Rugged equipment and components in this section are for factory assembled discrete equipment and components only and do not apply to site assembled or field assembled equipment or equipment anchorage. The list is based in part on OSHPD Code Application Notice 2-1708A.5.
- D. Special Certification requirements for Designated Seismic Systems (i.e. $Ip = 1.5$): Seismic Certificates of Compliance supplied by manufacturers shall be submitted for all components that are part of Designated Seismic Systems. In accordance with the ASCE 7, certification shall be via one of the following methods:
1. For active mechanical and electrical equipment that must remain operable following the design earthquake:
 - a. Testing as detailed by part C.1.b above.
 - b. Experience data as detailed by part C.1.c above.
 - c. Equipment that is considered “rugged” per part C.2 above.
 2. Components with hazardous contents shall be certified by the manufacturer as maintaining containment following the design earthquake by:
 - a. Testing as detailed by part C.1.b above.
 - b. Experience data as detailed by part C.1.c above.
 - c. Engineering analysis utilizing dynamic characteristics and forces. Tanks (without vibration isolators) designed by a registered design professional in accordance with ASME Boiler and Pressure Vessel Code, and satisfying the force and displacement requirements of Sections 13.3.1 and 13.3.2 of ASCE 7 having an importance factor, $Ip = 1.0$ shall be considered to satisfy the Special Seismic Certification requirements on the basis of ASCE 7 Section 13 .6.9.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. CalDyn (California Dynamics Corporation).
 3. ISAT (International Seismic Application Technology).
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. Vibro-Acoustics
 7. VMC (Vibration Mountings & Controls, Inc.)
- B. Elastomeric Isolation Pads P1:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.

2. Size: Factory or field cut to match requirements of supported equipment.
 3. Pad Material: Oil and water resistant with elastomeric properties.
 4. Surface Pattern: Ribbed pattern. [Retain first subparagraph below if galvanized-steel baseplates are adhered to the isolation pad to facilitate load distribution.
 5. Load-bearing metal plates adhered to pads.
- C. Elastomeric Hangers H1:
1. Description: Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods
 - a. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 - b. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.
- D. Spring Hangers H2: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and Insert in Compression.
 - a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - g. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- E. Spring Hangers with Vertical-Limit Stop H3: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and insert in Compression and vertical limit stop.
 - a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

- g. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- h. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. CalDyn (California Dynamics Corporation).
 - 3. ISAT (International Seismic Application Technology).
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Vibro-Acoustics
 - 7. VMC (Vibration Mountings & Controls, Inc.)
- B. Restrained Vibration Isolation Roof-Curb Rails: RC1:
- C. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
- D. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic forces.
- E. Lower Support Assembly: The lower support assembly shall be a formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- F. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch-thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic and wind restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch-thick.

- H. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailing of lower support assembly, and counterflashed over roof materials.

2.3 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. CalDyn (California Dynamics Corporation).
 3. ISAT (International Seismic Application Technology).
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. Vibro-Acoustics
 7. VMC (Vibration Mountings & Controls, Inc.)
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.
- D. Channel Support System: MFMA-4, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Cables located in exterior or other wet locations such as wash-down areas shall be stainless steel.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- G. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

- I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- L. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
- M. All post installed anchors utilized in the seismic design must be qualified for use in cracked concrete and approved for use with seismic loads.
- N. Expansion anchors shall not be used for anchorage of equipment with motors rated over 10 HP with the exception of undercut expansion anchors. Spring or internally isolated equipment are exempt from this requirement.
- O. All beam clamps utilized for vertical support must also incorporate retention straps.
- P. All seismic brace arm anchorages to include concrete anchors, beam clamps, truss connections, etc., must be approved for use with seismic loads.

2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 COORDINATION

- A. Coordinate with vibration/seismic restraint manufacturer and the structural engineer of record to locate and size structural supports underneath vibration/seismically restrained equipment (e.g. roof curbs, cooling towers and other similar equipment). Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions. Adjust isolators and restraints after piping systems have been filled and equipment is at its operating weight, following the manufacturer's written instructions.

3.3 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES and per the seismic restraint manufacturer's design.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.4 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Isolate all mechanical equipment 0.75 hp and over per the isolator and seismic restraint schedule and these specifications. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections
- C. All isolation materials and seismic restraints shall be of the same vendor and shall be selected and certified using published or factory certified data

- D. Installation of all vibration isolation materials, flexible connectors and supplemental equipment bases specified in this section shall be accomplished as per the manufacturer's written instructions with mountings adjusted to level equipment. Any variance or non-compliance with the manufacturer's instructions shall be reviewed and approved in writing by the manufacturer or corrected by the contractor in an approved manner.
- E. Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- F. Locate isolation hangers as near to the overhead support structure as possible.
- G. No rigid connections between isolated components and the building structure shall be made that degrades the noise and vibration control system herein specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls. "Components" includes, but is not limited to, mechanical equipment, piping and ducts.
- H. Coordinate work with other trades to avoid rigid contact with the building.
- I. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- J. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- K. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.
- L. Isolated equipment, duct and piping located on roofs must be attached to the structure. Supports (e.g., sleepers) that are not attached to the structure will not be acceptable.
- M. On completion of installation of all isolation materials and before startup of isolated equipment all debris shall be cleared from areas surrounding and from beneath all isolated equipment, leaving equipment free to move on the isolation supports.
- N. Horizontal Pipe Isolation: All HVAC pumped water, pumped condensate, glycol, and refrigerant piping size 1-1/4" and larger within mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50' or 100 pipe diameters from rotating equipment. For the first three (3) support locations from externally isolated equipment provide specification H2 or H3 hangers or specification S1, S2 or S3 mounts with the same deflection as equipment isolators (max 2"). All other piping within the equipment rooms shall be isolated with the same specification isolators with a 3/4" minimum deflection. Steam piping size 1-1/4" and larger which is within an equipment room and connected to rotating equipment shall be isolated for three (3) support locations from the equipment. Provide specification H2 or H3 hangers, or specification S1 or S2 mounts with the same deflection as equipment isolators but a minimum of 3/4".

- O. Install full line size flexible pipe connectors at the inlet and outlet of each pump, cooling tower, condenser, chiller, coiling connections and where shown on the drawings. All connectors shall be suitable for use at the temperature, pressure, and service encountered at the point of installation and operation. End fitting connectors shall conform to the pipefitting schedule. Control rods or protective braid must be used to limit elongation to 3/8". Flexible connectors shall not be required for suspended in-line pumps.
- P. All plumbing pumped water, piping size 1-1/4" and larger within mechanical rooms shall be isolated the same as HVAC piping above. Isolators are not required for any plumbing pumped water, pumped condensate, and steam piping outside of mechanical rooms unless listed in the isolation schedule.
- Q. Pipe Riser Isolation: The operating weight of all variable temperature vertical pipe risers 1-1/4" and larger, requiring isolation where specifically shown and detailed on riser drawings shall be fully supported by specification M1, M2 or R1 supports. S1, S2, S3, H2 or H3 steel spring deflection isolators with minimum 3/4-inch minimum shall be in those locations where added deflection is required due to pipe expansion and contraction. Spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Height saving brackets used with isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. Specification R1 riser supports shall be installed near the center point of the riser to anchor the riser when spring isolation is used. Specification R2 riser guides may be used in conjunction with spring isolators per design calculations. Pipe risers up through 16" shall be supported at intervals of every third floor of the building. Pipe risers 18" and over, every second floor. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Horizontal take-offs and at upper and lower elbows shall be supported with spring isolators as required to accommodate anticipated movement. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist if installed per design proposed.
- R. Where riser pipes pass through cored holes, core diameters shall be a maximum of 2" larger than pipe O.D. including insulation. Cored holes must be packed with resilient material or firestop as provided by other sections of this specification or local codes. Where seismic restraint is required specification isolator S3 shall support risers and provide longitudinal restraint at floors where thermal expansion is minimal and will not bind isolator restraints.
- S. Duct Isolation: Isolate all duct work with a static pressure 2" W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type H2 or H3 hangers or type S1 or S2 floor mounts.

3.5 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. On projects with Seismic Site Class A or B, seismic design or restraint is not required.
 - 2. On projects with Seismic Design Category C: Components with an importance factor of 1.0 do not require seismic design or restraint.

3. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
4. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
5. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, providing required submittals for component.
6. **Suspended Equipment:** All suspended equipment that meets any of the following conditions requires seismic restraints as specified by the supplier:
 - a. Rigidly attached to pipe or duct that is 75 lbs. and greater,
 - b. Items greater than 20 lbs and distribution systems weighing more than 5 lbs/lineal foot, with an importance factor of 1.0 hung independently or with flexible connections.
 - c. Possibility of consequential damage.
 - d. For importance factors greater than 1.0 all suspended equipment requires seismic restraint regardless of the above notes.
 - e. Wall mounted equipment weighing more than 20 lbs.
 - f. Exemptions:
 - 1) Equipment weighing less than 20 lbs and distribution systems weighing less than 5 lbs/lineal foot, with an $Ip = 1.0$ and where flexible connections exist between the component and associated ductwork, piping or conduit.
7. **Base Mounted Equipment:** All base mounted equipment that meets any of the following conditions requires attachments and seismic restraints as specified by the supplier:
 - a. Connections to or containing hazardous material,
 - b. With an overturning moment.
 - c. Weight greater than 400 lbs.
 - d. Mounted on a stand 4 ft. or more from the floor
 - e. Possibility of consequential damage.
 - f. For importance factors greater than 1.0 all base mounted items require seismic restraints regardless of the above notes.
 - g. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
 - h. Exemptions:
 - 1) Floor or curb-mounted equipment weighing less than 400 lbs and not resiliently mounted, where the Importance Factor, $Ip = 1.0$, the components are mounted at 4 feet or less above a floor level, flexible connections between the components and associated duct work, piping and conduit are provided and there is no possibility of consequential damage.
8. **Roof Mounted Equipment:**
 - a. To be installed on a structural frame, seismically rated roof curb, or structural curb frame mechanically connected to the structure. Items shall not be mounted onto sleepers or pads that are not mechanically and rigidly attached to the structure. Restraint must be adequate to resist both seismic and wind forces.
 - b. Roof curbs shall be installed directly to building structural steel or concrete roof deck and not to top of steel deck or roofing material.
 - c. Exemptions:
 - 1) Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.
9. **Rigid Mounted Equipment:**

- a. Anchor floor and wall mounted equipment to the structure as per the stamped seismic certifications / drawings.
 - b. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
 - c. Suspended equipment shall be restrained using seismic cable restraints, or struts, and hanger rods as per the stamped seismic certifications / drawings.
10. Vibration Isolated Equipment:
- a. Seismic control shall not compromise the performance of noise control, vibration isolation or fire stopping systems.
 - b. Equipment supported by vibration-isolation hangers shall be detailed and installed with approximately a 1/8" gap between the isolation hangers and the structure. Isolators at restraint locations must be fitted with uplift limit stops.
- B. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- C. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- E. Installation and adjustment of all seismic restraints specified in this section shall be accomplished as per the manufacturer's written instructions. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.
- F. Piping Restraints:
1. Comply with requirements in MSS SP-127.
 2. Seismically restrain piping, with an $Ip = 1.0$, located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is $1\frac{1}{4}$ " I.D. and larger.
 3. Seismically restrain all other $Ip = 1.0$ piping $2\frac{1}{2}$ " diameter and larger.
 4. Seismically restrain all $Ip = 1.5$ piping larger than 1" diameter.
 5. Branch lines may not be used to brace main lines.
 6. Exemptions:
 - a. All high deformability pipe 3" or less in diameter suspended by individual hanger rods where $Ip = 1.0$.
 - b. High deformability pipe or conduit in Seismic Design Category C, 2" or less in diameter suspended by individual hanger rods where $Ip = 1.5$.
 - c. High deformability pipe in Seismic Design Category D, E or F, 1" or less in diameter suspended by individual hanger rods where $Ip = 1.5$.
 - d. All clevis supported pipe runs installed less than 12" from the top of the pipe to the underside of the support point and trapeze supported pipe suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.
 - e. Piping systems, including their supports, designed and constructed in accordance with ASME B31.
 - f. Piping systems, including their supports, designed and constructed in accordance with NFPA, provided they meet the force and displacement requirements of Section 13.3.1 and 13.3.2 (ASCE 7).

- G. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.
- H. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.
- I. Where pipe sizes reduce below dimensions required for seismic, the final restraint shall be installed at the transition location.
- J. Restraint Spacing For Piping: Sizes shown are maximum. Actual spacing determined by calculation.
 - 1. For non-ductile piping (e.g., cast iron, PVC) space transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
 - 2. For piping with hazardous material inside (e.g., natural gas, medical gas) space Transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
 - 3. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.
 - 4. For all other ductile piping see Table "A" below
- K. Seismic Restraint of Ductwork: Seismically restrain per specific code requirements, all ductwork listed below (unless otherwise indicated on the drawings), using seismic cable restraints:(Ductwork not meeting criteria listed below)
 - 1. Restrain rectangular ductwork with cross sectional area of 6 square feet or larger. Duct with an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.
 - 2. Restrain round ducts with diameters of 28" or larger. Duct with an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.
 - 3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
 - 4. Duct must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze. Additional reinforcing is not required if duct sections are mechanically fastened together with frame bolts and positively fastened to the duct support suspension system.
 - 5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
 - 6. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
 - 7. If ducts are supported by angles, channels or struts, ducts shall be fastened to it at seismic brace locations in lieu of duct reinforcement.
 - 8. All ductwork weighing more than 17 lb/ft.
 - 9. Exemptions:
 - a. Duct runs supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork. This exemption does not apply to ducts with an importance factor of 1.5.
 - 10. See Table "A" below for restraint spacing.

L. Exemptions do not apply for:

1. Life Safety or High Hazard Components
 - a. Including gas, fire protection, medical gas, fuel oil and compressed air needed for the continued operation of the facility or whose failure could impair the facility's continued operation, Occupancy Category IV, IBC-2009 as listed in Section 1.3 B regardless of governing code for HVAC, Plumbing, Electrical piping or equipment. (A partial list is illustrated.) High Hazard is additionally classified as any system handling flammable, combustible or toxic material. Typical systems not excluded are additionally listed below.
2. Piping
 - a. Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Fire Sprinkler Branch Lines must be end tied.
3. Duct
 - a. Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override.

M. Spacing Chart For Suspended Components:

Table "A" Seismic Bracing (Maximum Allowable Spacing Shown- Actual Spacing to Be Determined by Calculation)			
Equipment	On Center Transverse	On Center Longitudinal	Change Of Direction
Duct			
All Sizes	30 Feet	60 Feet	4 Feet
Pipe Threaded, Welded, Soldered Or Grooved			
To 16"	40 Feet	80 Feet	4 Feet
18" – 28"	30 Feet	60 Feet	4 Feet
30" – 40"	20 Feet	60 Feet	4 Feet
42" & Larger	10 Feet	30 Feet	4 Feet

- N. Roof mounted duct is to be installed on sleepers or frames mechanically connected to the building structure. Roof anchors and seismic cables or frames shall be used to resist seismic and wind loading. Wind loading factors shall be determined by the registered design professional.
- O. Where duct sizes reduce below dimensions required for seismic restraint the final restraint shall be installed at the transition location.
- P. Install cables so they do not bend across edges of adjacent equipment or building structure.
- Q. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- R. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

- S. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- T. Seismically Rated Beam Clamps are required where welding to or penetrations to steel beams are not approved.
- U. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections.
 - 1. A representative of the vibration isolation system manufacturer shall review the project installation and provide documentation indicating conformance to vibration isolation design intent
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.
 - 1. The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

3.7 SPECIAL INSPECTIONS

- A. Special Inspection Requirements: All Designated Seismic Systems are subject to Special Inspection per IBC Chapter 17. The seismic restraint manufacturer will provide a special

inspection plan to the contractor for submittal to the owner and design team for use by the projects special inspectors. The plan will include the following:

1. A list of all components of the seismic system that require inspection of testing.
 2. The required frequency of testing and inspection.
 3. Type and nature of testing required.
- B. Special inspection for mechanical components shall be provided as follows:
1. Periodic special inspection during the installation for flammable, combustible or highly toxic piping systems and their associated mechanical units in Seismic Design Categories C, D, E or F.
 2. Periodic special inspection during the installation of HVAC ductwork that will contain hazardous materials in Seismic Design Categories C, D, E or F.
 3. Periodic special inspection during the installation of vibration isolation systems where the construction documents indicate a maximum clearance (air gap) between the equipment support frame and restraint less than or equal to 1/4 inch.
 4. Pipe, 3" and larger.
 5. Isolator units for seismic isolation system.
 6. Manufacturer's written Quality Control Program for projects in Seismic Design Categories E or F.

3.8 IDENTIFICATION

- A. Install identification tags at all seismic brace locations. Tags to include the following information:
1. Specific seismic forces (g-force) the location was designed to resist.
 2. Maximum brace reaction at connection to structure.
 3. For single hung items, the maximum pipe/conduit size the brace location was designed to accommodate.
 4. For trapeze supported items, the maximum weight (lbs/lf) the brace location was designed to accommodate.
 5. For suspended equipment, the maximum unit operating weight (lbs) the brace location was designed to accommodate.
 6. Location identifier cross matched to that on plan set layout.
 7. Company name of installing contractor.

3.9 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
 1. Adjust active height of spring isolators.
- C. 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.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration and Training."

LOCATION	EQUIPMENT ISOLATION SCHEDULE			B' UPPER STORY (20'-35' SPAN)			C' GRADE		
	A' CRITICAL (35'-50' SPAN)			ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE
EQUIPMENT (1)									
CENTRIFUGAL FANS CL. I & II UP TO 54-112" W.D. UPT015HP	S3	1.5	SB1	S3	0.75	SB1	S3	0.75	SB1

B. NOTES:

- C. 1) Thrust restraints required on all high-pressure fan section, suspended axial-flow fans and on floor-mounted axial fans operating at 3.0" S.P. or greater.

END OF SECTION 230548

SECTION 230553 – IDENTIFICATION FOR PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes mechanical identification materials and devices.
- B. Provide red lettering on the ceiling tiles of the locations of all fire dampers, smoke dampers and fire /smoke dampers. Size of lettering and verbiage is to conform to IBC and NFPA standards.
- C. All specialty gas piping shall be identified.

1.3 SUBMITTALS

- A. Product Data: For identification materials and devices.
- B. Samples: Of color, lettering style and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

- A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

A.General: Products specified are for applications referenced in other Division 22 & 23 Sections. If more than single type is specified for listed applications, selection is Installer's option.

B.Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

C.Stencils: Standard stencils, prepared with letter sizes conforming to recommendations of ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.

D. Stencil Paint: Exterior, oil-based, alkyd gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.

E. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

F.Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

G. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

H.Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least 3 times letter height and of length required for label.

I.Lettering: Manufacturer's standard preprinted captions as selected by Engineer.

J.Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

K.Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.

L.Plastic Duct Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cold-air supply.
2. Yellow: Hot-air supply.
3. Blue: Exhaust, outside, return, and mixed air.

4. Hazardous Material Exhausts: Use colors and designs recommended by ASME A13.1.
5. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin, duct destination, and design flow.

M. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

N. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick, polished brass..
2. Size: 1-1/2-inches diameter, unless otherwise required.
3. Indicate valve service and normal position on valve. Example Cold water, N.O.

O. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

P. Valve Tag Fasteners: Brass, wire-link chain; beaded chain; or S-hooks.

Q. Access Panel Markers: 1/16-inch- thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch center hole for attachment.

R. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Brown: Energy reclamation equipment and components.
4. Blue: Equipment and components that do not meet criteria above.
5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
6. Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

S. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

PART 3– EXECUTION

3.1 LABELING DUCTS AND PIPES

A. Duct and Piping systems shall be identified by:

1. Background color
2. Lettering color, and
3. Flow Direction Arrow

B. Duct and Piping Background Color shall be applied to all exposed piping (either over bare pipe or the insulation) in mechanical rooms. Identifying lettering and arrows shall then be added as indicated above, and as necessary to be visible from anywhere in the room.

1. For duct in mechanical rooms, chases and other exposed areas, as well as piping routed in other exposed areas such as chases, background color shall be applied in a two foot (2'0") wide band with identifying lettering and a flow direction arrow.
2. Background and lettering shall be semi-gloss enamel paint by DeVoe (Mirrolac), Pratt and Lambert, Glidden, Rust-Oleum, Sherwin Williams or approved equal. The colors specified herein shall not be varied.

Color	Sherwin Willia ms	Pratt & Lambert	Rust-Oleum		
Red	SW4081 Safety Red	1007 Vibrant Red	964	Federal Safety Red	
Orange	SW4083 Safety Orange	S4507 Safety Orange	956	Federal Safety Orange	
Yellow	SW4084 Safety Yellow	1732 Spectru m Yellow	944	Federal Safety Yellow	
Green	SW4085 Safety Green	Safety Green	933	Federal Safety Green	
Blue	SW4086 Safety Blue	1228 Anchors Aweigh	925	Federal Safety Blue	
Purple	SW4080 Plum	Bright Mediu m	Bright Mediu m		

Silver (Alu minu m)	B59S11 Silver Brite	--	--
Black	Black	Effecto Black	634 Black
White	White	Effecto White	2766 White
Brown	SW4001 Bolt Brown	2278 Char Brown	--

3. Identifying lettering shall be painted or stenciled on duct or pipe over the background color. Self-adhesive or glue-one type labels are acceptable. Letters shall be 2" high for duct and larger piping 3" or more, 1" high for 1-14" to 2-1/2" pipe, and 1/2" high for 1" pipe and smaller.
4. Arrows to indicate direction of flow shall be painted over the background color in the same color as the lettering. The arrow shall point away from the lettering. On large piping 3" or more in diameter, the "shaft" of the arrow shall be 2" long and 1" wide. Smaller piping, 2-1/2" or less, shall have arrows with a shaft 1/2" wide and 2" long. Use a double-headed arrow if the flow can be in either direction.
 - a. Piping shall be identified as follows:

3.2 LABELING AND IDENTIFYING PIPING SYSTEMS

- A. Install pipe markers on each system. Include arrows showing normal direction of flow.
- B. Marker Type: Stenciled markers with painted, color-coded bands complying with ASME A13.1.
- C. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, noninsulated pipes.
- D. Fasten markers on pipes and insulated pipes by one of following methods:
 1. Snap-on application of pretensioned, semirigid plastic pipe marker.
 2. Adhesive lap joint in pipe marker overlap.
 3. Laminated or bonded application of pipe marker to pipe or insulation.
 4. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 3/4 inch wide, lapped a minimum of 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 5. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 1-1/2 inches wide, lapped a minimum of 3 inches at both ends of pipe marker, and covering full circumference of pipe.

E. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations according to the following:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
3. Near penetrations through walls, floors, ceilings, or nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.3 VALVE TAGS

A. Install on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. Indicate service and normal position of all tagged valve and control devices. List tagged valves in valve schedule.

B. Tag Material: Brass.

3.4 EQUIPMENT SIGNS AND MARKERS

A. Install engraved plastic-laminate signs or equipment markers on or near each major item of mechanical equipment. Include signs for the following general categories of equipment:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Fire department hose valves and hose stations.
3. Meters, gages, thermometers, and similar units.
4. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
5. Pumps, compressors, chillers, condensers, and similar motor-driven units.
6. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
7. Fans, blowers, primary balancing dampers, and mixing boxes.
8. Packaged HVAC central-station and zone-type units.
9. Tanks and pressure vessels.
10. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

B. Optional Sign Types: Stenciled signs may be provided instead of engraved plastic, at Installer's option, where lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.

1. Lettering Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Terms on Signs: Distinguish between multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows showing service and direction of flow.

1. Location: Locate signs near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.
- B. Clean faces of identification devices and glass frames of valve charts.

END OF SECTION 230553

B L A N K P A G E

SECTION 230594 - GENERAL TESTING, ADJUSTING, BALANCING AND COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Measuring sound and vibration.
7. Reporting results of the activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.

- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. NEBB: National Environmental Balancing Bureau.
- P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. Contract Documents Examination Report: Within 90 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.
- B. Strategies and Procedures Plan: Within 120 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.
- C. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- D. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.
- E. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB. Balancing may only be performed by the following:
 - 1. Bonneville Test & Balance.
 - 2. BTC Service.
 - 3. Certified Test & Balance.
 - 4. RS Analysis.
- B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 14ays' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. Contract Documents examination report.
 - c. Testing, adjusting, and balancing plan.
 - d. Work schedule and Project site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" or frame NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

- F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. National Project Performance Guarantee: Provide a guarantee on AABC or NEBB forms stating that AABC or NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
1. The certified Agent has tested and balanced systems according to the Contract Documents.
 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

GENERAL TESTING, ADJUSTING & BALANCING

230594 - 4

**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in Division 1 Section "Project Record Documents."
- D. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- F. Examine system and equipment test reports.
- G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- I. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

- K. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- L. Examine strainers for clean screens and proper perforations.
- M. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- O. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.
- P. Examine equipment for installation and for properly operating safety interlocks and controls.
- Q. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to design values.
- R. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.

5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC or NEBB national standards and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multizone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 2. Measure static pressure across each air-handling unit component.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers under final balanced conditions.
 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 5. Adjust fan speed higher or lower than design to achieve design conditions. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating if high-efficiency motor.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.7 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.8 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.9 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans: Plus 5 to minus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.

3.10 REPORTING

GENERAL TESTING, ADJUSTING & BALANCING

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- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of testing, adjusting, and balancing Agent.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
 - 10. Summary of contents, including the following:
 - 11. Design versus final performance.
 - 12. Notable characteristics of systems.
 - 13. Description of system operation sequence if it varies from the Contract Documents.

14. Nomenclature sheets for each item of equipment.
15. Data for terminal units, including manufacturer, type size, and fittings.
16. Notes to explain why certain final data in the body of reports vary from design values.
17. Test conditions for fans and pump performance forms, including the following:

- a. Settings for outside-, return-, and exhaust-air dampers.
- b. Conditions of filters.
- c. Cooling coil, wet- and dry-bulb conditions.
- d. Fan drive settings, including settings and percentage of maximum pitch diameter.
- e. Settings for supply-air, static-pressure controller.
- f. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.

F. Equipment Test Reports: For all equipment tested:

1. Unit Data: Include the following:
 2. Unit identification.
 3. Location.
 4. Make and type.
 5. Model number and unit size.
 6. Manufacturer's serial number.
 7. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
8. Test Data: Include design and actual values for the following: (all elements of the system that were tested, including air and water flows, static pressures, pump hoods, inlet and outlet static pressures, inlet, outlet pressure type of coils, raws, circuits face areas, inlet, outer wet bulb, dry bulb temperatures, duct sizes tested, inlet and outlet flows temperatures and pressures and all other pertinent data. The report to be organized per each item tested.)
 - a. Total rate in cfm, gpm and lbs/hr.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.

- e. Filter static-pressure differential in inches wg.
- f. Outside airflow in cfm.
- g. Return airflow in cfm.
- h. Outside-air damper position.
- i. Return-air damper position.

G. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.12 WARRANTY

A. During the first year and as part of the warrantee period this division shall make the necessary adjustment to change air pressurization, volumes on the air and water systems at no cost to the owner.

3.13 ADDITIONAL TESTS

- A. Within 120 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230594

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SECTION 23 0719 HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 1. Condensate drain piping.
 2. Chilled-water piping.
 3. Heating hot-water piping.

1.03 DEFINITIONS:

- A. Refer to Section 230500 "Common Work Results for HVAC".

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.08 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.09 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Insulation for below-ambient service requires a vapor-barrier.

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- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553,
 - 1. Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- J. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000-Degree Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.

- d. Owens Corning; Fiberglas Pipe Insulation.
 - e. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A:
 - 1) with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied:
1. ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- L. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. Eagle Bridges - Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller

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- Company; 81-27.
- d. Mon-Eco Industries, Inc.; 22-30.
- e. Vimasco Corporation; 760.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Aeroflex USA, Inc.; Aeroseal.
- b. Armacell LLC; Armaflex 520 Adhesive.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
- d. K-Flex USA; R-373 Contact Adhesive.
2. 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).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
- b. Eagle Bridges - Marathon Industries; 225.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
- d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
- b. Eagle Bridges - Marathon Industries; 225.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
- d. Mon-Eco Industries, Inc.; 22-25.
2. 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).
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Dow Corning Corporation; 739, Dow Silicone.

- b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
2. 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).

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges- Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.

- d. Mon-Eco Industries, Inc.; 55-50.
- e. Vimasco Corporation; WC-1/WC-5.
- 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F.
- 4. Solids Content: 60 percent by volume and 66 percent by weight.
- 5. Color: White.

2.05 SEALANTS

- A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.07 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: Color-code jackets based on system:
 - a. White
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless-Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications:
 - 1) 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications:
 - 1) 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

2.09 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

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- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at
 - a. 2 inches o.c.
 - b. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking

due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps,

test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
 3. Finish fittings insulation same as pipe insulation.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 2. Install insulation to flanges as specified for flange insulation application.
 3. Finish valve and specialty insulation same as pipe insulation.

3.07 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions

3. with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.09 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, 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.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and

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Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric:
 - 1) 1/2 inch thick
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 1) 1/2 inch thick
- B. Chilled Water, above 40 Deg F:
 1. NPS 1-1/2 inch and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric:
 - 1) 1-1/2 inch thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I:
 - 1) 1-1/2 inch thick.
 2. NPS 2 inch and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric:
 - 1) 1-1/2 inch thick.

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- b. Mineral-Fiber, Preformed Pipe, Type I:
 - 1) 1-1/2 inches thick.
 - 3. Insulation runouts not exceeding 48 inches in length for connection to equipment shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick
- C. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
- 1. NPS 1 1/2 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I:
 - 1) 1-1/2 inch thick
 - 2. Greater than NPS 1-1/2 inch: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I or Pipe and Tank Insulation:
 - 1) 2 inches thick
 - 3. Insulation for runouts not exceeding 48 inches in length for connection to equipment shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
- D. Piping, Exposed:
 - 1. PVC:
 - a. White: 30 mils thick.

END OF SECTION 23 0719

SECTION 23 2113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Air-vent piping.
4. Dielectric fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 1. Copper pipe, tubing and fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Suspended ceiling components.
 2. Other building services.
 3. Structural members.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports: Written reports as specified in Part 3 of this section including:
 1. Test procedures used.
 2. Test results showing compliance with specified requirements.
 3. Failed test results with corrective action taken to achieve compliance with specified requirements.

1.5 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.6 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

2.2 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts Regulator Co.
 - e. Zurn Industries, LLC.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 deg F. [150 psig] [175 psig] [300 psig].
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- C. Dielectric-Flange Insulating Kits:
 - 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- D. Dielectric Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
 - 2. Description:
 - a. Standard: IAPMO PS 66.
 - b. Electroplated steel nipple, complying with ASTM F 1545.

- c. Pressure Rating: 300 psig at 225 deg F.
- d. End Connections: Male threaded
- e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be [any of] the following:
 - 1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be [any of] the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be [any of] the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be [any of] the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- F. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- G. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

- A. PRE-WORK / PRE-REQUISITES
 - 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
 - 2. The Contractor shall study the architectural, structural, mechanical, electrical and other drawings to eliminate conflict of piping with other structure lighting or other services.
- B. CONDITION
 - 1. All installed pipelines shall be free from dents, scars, and burrs, with ends reamed smooth.
 - 2. All piping shall be clean and free from acids and loose dirt when installed and shall be kept clean during the completion of the installation.
 - 3. Install piping free of sags and bends.
 - 4. All installed pipelines shall remain straight against strains tending to cause distortion during system operation. The contractor shall make proper allowance for pipe line expansion and contraction so that no unsightly distortion, noise, damage or improper operation results therefrom.
- C. SELECTION
 - 1. Select system components with pressure rating equal to or greater than system operating pressure.
 - 2. No street type fittings shall be used.
 - 3. No short nipples shall be used except at drain valves.
 - 4. Plugs of rags, wools, cottons, waste, or similar materials may not be used for plugging.

D. ROUTING/ARRANGEMENT

1. Piping installations shall be neatly organized.
2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
3. Install groups of pipes parallel to each other.
4. Install piping spaced to permit application of insulation.
5. Install piping parallel and spaced to permit the servicing of valves.
6. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls or axis of the building.
7. Diagonal runs are prohibited unless specifically indicated otherwise.
8. Install fittings for all changes in direction.
9. No piping shall be run above any electrical panels, electrical equipment or access clearances for electrical for electrical panels or equipment. No piping shall be allowed to run through any electrical rooms.
10. Piping shall be arranged, placed and installed to facilitate equipment maintenance and shall be so arranged to not interfere with the installation of the air-conditioning equipment, ducts, or the removal of other equipment or devices. All specialties shall be so placed to permit easy operation and access.
11. All piping shall be so installed to insure noiseless circulation.
12. Install fittings for all branch connections.
13. Unless otherwise indicated, install branch connections to mains using [mechanically formed] tee fittings or forged steel branch fittings in main pipe, with the branch connected to the bottom of the main pipe.
14. For up-feed risers, connect the branch to the top of the main pipe.
15. Forged branch fittings shall be installed per the manufacturer's recommendations.

E. ACCESS / ARRANGEMENT

1. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal. All piping shall be so arranged to not block access to manholes, access openings, etc.
2. Install piping at indicated slopes. If not indicated, install piping at a uniform grade of 0.2 percent upward in direction of flow. Traps are to be avoided where-ever possible.
3. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
4. When insulated pipes are supported by a roller hanger they shall be protected from damage by suitable pipe covering protection saddles. Saddles shall support pipe on roller and shall be packed with insulation.
5. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, at each coil on all sides of automatic valves where valves do not have union connections, elsewhere as indicated, and wherever necessary to prevent undue difficulty in making repairs or replacement. Unions are not required at flanged connections.
6. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated. Install flanges on valves, apparatus, and equipment having 2 1/2 inch NPS and larger connections. Flanges or unions as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment.
7. Install sleeves for piping penetrations of walls, ceilings, and floors.
8. Install sleeve seals for piping penetrations of concrete walls and slabs.
9. Install escutcheons for piping penetrations of walls, ceilings, and floors.
10. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration-producing equipment.
11. Polypropylene pipe in or passing through plenums must be fire wrapped or installed in a metal conduit.

F. DRAINAGE

1. Drain valves shall be installed at all low points in all piping systems to allow for complete drainage of piping systems.
2. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

3. All piping systems shall be installed so that they can be easily drained by means of drainage of low points of all piping without disconnecting pipe.
4. If not specifically indicated on the drawings, the frequency of draining shall determine whether drain caps, plugs, cocks, or valves are to be used.

G. IDENTIFICATION

1. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Steel roof deck shall not be used to support loads from piping, ductwork or equipment, unless noted otherwise. Hanger loads less than 50 lbs. may be hung from the steel roof deck in cases when hanging from the steel roof deck cannot be avoided; the attachment method must distribute the load across the deck as approved by the Structural Engineer.
- D. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- E. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4: Maximum span, 7 feet.
 2. NPS 1: Maximum span, 7 feet.
 3. NPS 1-1/2: Maximum span, 9 feet.
 4. NPS 2: Maximum span, 10 feet.
 5. NPS 2-1/2: Maximum span, 11 feet.
 6. NPS 3 and Larger: Maximum span, 12 feet.
- F. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
 - D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
 - E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 - F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- 3.6 TERMINAL EQUIPMENT CONNECTIONS**
- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

END OF SECTION

SECTION 23 2116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
 1. Hot-water heating piping.
 2. Makeup-water piping.
 3. Condensate-drain piping.
 4. Air-vent piping.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 2. Air-control devices.
 3. Hydronic specialties.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.05 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 VIII, Division 1.

PART 2 - PRODUCTS

2.01 VALVES

- A. **Globe, Check, Ball, and Butterfly Valves:** Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping. Gate valves are not allowed on this project.

- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC."
- C. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- D. Bronze, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 and smaller:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company.
 - h. Nexus Valve, Inc.
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Threaded or socket.
 - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position.
 - 9. CWP Rating: Minimum **125 psig**.
 - 10. Maximum Operating Temperature: **250 deg F**.
- E. Cast-Iron or Steel, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 1/2 and larger:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Flow Design Inc.
 - e. Gerand Engineering Co.
 - f. Grinnell.
 - g. Griswold Controls.
 - h. Taco.
 - i. Tour & Andersson; available through Victaulic Company.
 - j. Spence Engineering Company Inc.
 - k. Watts Regulator Co.
 - l. Nexus Valve, Inc.
 - 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Stem Seals: EPDM O-rings.
 - 5. Disc: Glass and carbon-filled PTFE.
 - 6. Seat: PTFE.

7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum **125 psig**.
11. Maximum Operating Temperature: **250 deg F**.

F. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: **Brass**, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Kunkle.
 - f. Spence Engineering Company, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: **Brass**, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Griswold Controls.
 - e. Taco
 - f. Nexus Valve, Inc.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Tamper proof, self-cleaning, and removable, for inspections and replacement.
 - a. **Corrosion resistant.**
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Attached by chain and marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations:
 - a. **Minimum CWP Rating: 175 psig.**
8. **Maximum Operating Temperature: 200 deg F.**
9. Fitted with pressure and temperature test valves.
10. Equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case.

2.02 AIR-CONTROL DEVICES

- A. Manual Air Vents:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
 2. Body: Bronze.
 3. Internal Parts: Nonferrous.
 4. Operator: Screwdriver or thumbscrew.
 5. Manually operated with ball valve in the down position.
 6. Inlet Connection: **NPS 1/2.**
 7. Discharge Connection: **NPS 1/8.**
 8. CWP Rating: **150 psig.**
 9. Maximum Operating Temperature: **225 deg F.**
- B. Automatic Air Vents:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Bell & Gossett Domestic Pump.

- c. Hoffman Specialty ITT; Fluid Handling Div.
 - d. Spirax-Sarco.
 - e. Spirovent.
 - f. Taco, Inc.
 - g. Honeywell-Baukman.
2. Body: Bronze or cast iron.
 3. Internal Parts: Nonferrous.
 4. Operator: Noncorrosive metal float.
 5. Inlet Connection: **NPS 1/2**.
 6. Discharge Connection: **NPS 1/4**.
 7. CWP Rating: **150 psig**.
 8. Maximum Operating Temperature: **240 deg F**.

C. **Bladder** -Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
2. Tank: Welded steel, rated for **125-psig** working pressure and **240 deg F** maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. **Bladder** : Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
5. Access: Drain fitting and taps for pressure gage.
6. Support:
 - a. Vertical tanks with steel legs or base.
 - b. Horizontal tanks with steel saddles.

D. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
2. Tank: Welded steel; ASME constructed and labeled for **125-psig** minimum working pressure and **240 deg F** maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.

4. Tangential Inlet and Outlet Connections: Threaded for **NPS 2** and smaller; flanged connections for **NPS 2-1/2** and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.
- 7.

2.03 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Machine Works.
 - b. Hoffman Specialty ITT; Fluid Handling Div.
 - c. Metraflex Co.
 - d. Mueller
 - e. Spirax Sarco.
 - f. Trane Co.
 - g. Tour & Andersson; available through Victaulic Company.
 - h. Watts Regulator Co.
 - i. Nexus Valve
2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2-1/2** and larger.
4. Strainer Screen: Stainless-steel, or perforated stainless-steel basket:
 - a. **20-mesh** strainer.
5. CWP Rating: **125 psig**.

B. Basket Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Metraflex Co.
 - c. Mueller
 - d. Spirax Sarco.
 - e. Tour & Andersson; available through Victaulic Company.
2. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2-1/2** and larger.
4. Strainer Screen: Perforated stainless-steel basket with 50 percent free area:
 - a. **40-mesh startup strainer**.
5. CWP Rating: **125 psig**.

C. Spherical, Rubber, Flexible Connectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the

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following:

- a. Amber-Booth.
 - b. Mason Industries.
 - c. Metraflex Co.
 - d. Flex-Weld.
 - e. Fugate.
 - f. Twin City Hose.
 - g. Nexus Valve, Inc.
2. Body: Double-sphere fiber-reinforced EPDM rubber body.
 3. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
 4. Performance: Capable of misalignment.
 5. CWP Rating: **150 psig**.
 6. Maximum Operating Temperature: **250 deg F**.

D. Diverting Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
2. Body: Cast Iron or Wrought Copper
3. Ends: Threaded or Soldered
4. Flow Direction: Indicated on fitting.
5. CWP Rating: **125 psig**.
6. Maximum Operating Temperature: **250 deg F**.

PART 3 - EXECUTION

3.01 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. **Install calibrated-orifice**, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere 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.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.02 HYDRONIC SPECIALTIES INSTALLATION

HYDRONIC PIPING SPECIALTIES

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- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Automatic air vents may cause damage to ceilings and other finished surfaces. Air vents aid in system filling. Air removal after initial startup is accomplished by air separator or boiler diptube. Manual air vents may be a better solution.
- C. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- D. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- E. Install in-line air separators in pump suction. Install drain valve on air separators **NPS 2** and larger.
- F. Install tangential air separator in pump suction. Install blowdown piping with full-port ball valve; extend full size to nearest floor drain.
- G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 23 2116

SECTION 250205 – FIELD DEVICES FOR BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Air-temperature sensors.
2. Space-temperature sensors
3. Space occupancy sensors
4. Airflow sensors
5. Damper actuators
6. Current sensors

1.3 SUBMITTALS

- A. Action Submittals

1. Product Data: For each type of product, including the following:
 - a. Field device matrix: provide a matrix of all field devices including generic description, specification reference, model number and application. This must be submitted with the produce information. Produce information will not be approved without this matrix.
 - b. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - c. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
 - d. Product description with complete technical data, performance curves, and product specification sheets.
 - e. Installation operation and maintenance instructions, including factors affecting performance.

- B. Informational Submittals

1. Product Certificates: For each product requiring a certificate.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

2.2 AIR-TEMPERATURE SENSORS

A. Platinum RTDs: Common Requirements:

1. 1000 ohms at zero deg. C and a temperature coefficient of 0.00385 ohm/ohm/deg. C.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:

- a. Range: Minus 50 to 275 deg F.
- b. Accuracy: Plus or minus 0.2 percent at calibration point.
- c. Repeatability: Within 0.5 deg F.
- d. Self-Heating: Negligible.

B. Platinum RTD, Single-Point Air Temperature Duct Sensors:

1. Probe: Single-point sensor with a stainless-steel sheath.
2. Length: As required by application to achieve tip at midpoint of air tunnel, up to 18 inches.
3. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
4. Gasket for attachment to duct or equipment to seal penetration airtight.

2.3 SPACE TEMPERATURE SENSORS

A. Temperature Sensors for Unit Controllers: Each unit controller shall be provided with a matching room temperature sensor.

1. Auxiliary Communication Port. Each space temperature sensor shall include an integral terminal jack used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. RS-232 communications port shall allow the operator to query and modify operating parameters of the local room terminal unit from a portable operator's terminal.
2. Plain Space Temperature Sensors: Where called for on the drawings, provide sensors with plain covers.

- a. The sensing element for the space temperature sensor shall be thermistor type providing the following.
 - 1) Element Accuracy: +/- 1.0°F
 - 2) Operating Range: 55 to 95°F
 - 3) Set Point Adjustment Range: 55 to 95°F
 - 4) Calibration Adjustments: None required
 - 5) Installation: Up to 100 ft. from controller
- 3. Digital display temperature sensor :
 - a. As called for on the drawings, provide temperature sensors with digital displays.
 - b. The sensing element for the space temperature sensor must be IC-based and provide the following.
 - 1) IC Element Accuracy: +/- 0.9°F
 - 2) Operating Range: 55 to 95°F
 - 3) Setpoint Adjustment Range: User limiting, selectable range between 55 and 95°F
 - 4) Calibration: Single point, field adjustable at the space sensor to +/- 5°F
 - 5) Installation: Up to 100 ft. from controller
 - 6) OLED Temperature Display
 - 7) Display of temperature setpoint with numerical temperature values to one decimal place.
 - 8) Display of temperature setpoint graphically, with a visual Hotter/Colder setpoint indication
 - 9) Tamper proof temperature sensor:
 - c. Where called for on the drawings, provide sensors with tamper proof covers.
 - d. The sensing element for the space temperature sensor shall be thermistor type secured to the back of a blank cover plate, suitable for mounting in a standard electrical box. Attachment by tamper proof screws/. No communication port is required.
 - 1) Element Accuracy: +/- 1.0°F
 - 2) Operating Range: 55 to 95°F
 - 3) Set Point Adjustment Range: 55 to 95°F
 - 4) Calibration Adjustments: None required
 - 5) Installation: Up to 100 ft. from controller
 - 6) Cover Plate: Stainless steel, brushed finish.
- 4. Provide the following options as they are called for on the drawings:
 - a. Setpoint Adjustment. The setpoint adjustment function shall allow for modification of the temperature by the occupant or building operator. Setpoint adjustment may be locked out, overridden, or limited as to time or temperature through software by an operator at any workstation, Building Controller, room sensor two-line display, or via a portable operator's terminal.
 - b. Override Switch. An override button shall initiate override of the night setback mode

to normal (day) operation when activated by the occupant and enabled by building operators. The override shall be limited to two (2) hours (adjustable.) The override function may be locked out, overridden, or limited through software by an operator at the operator interface, Building Controller, room sensor two-line display or via a portable operator's terminal.

2.4 SPACE OCCUPANCY SENSORS

- A. Where shown on the drawings or described by the sequences of operation provide occupancy sensors.
- B. Occupancy sensors shall use passive infrared detection having the ability to detect low activity level occupants.
- C. Detectors shall provide separately adjustable on and off delays.
- D. Units shall be wall- or ceiling- mounted as required for space coverage. Provide sufficient quantity for each space for complete coverage.

2.5 AIRFLOW SENSORS AND TRANSMITTERS:

- A. Transmitters for Pitot Tube Airflow Stations:
 - 1. Basis of Design Product: Air Monitor Corporation; DPT 2500 Plus.
 - 2. Transmitter shall receive total- and static-pressure signals from a flow element, amplify signals, extract the square foot, and scale the signals to produce 4- to 20-mA dc output signals linear to airflow.
 - 3. NEMA 250, Type 1 enclosure.
 - 4. Construct assembly so shock, vibration, and pressures surges of up to 1 psig will neither harm transmitter, nor affect its accuracy.
 - 5. Transmitter with automatic zeroing circuit capable of automatically readjusting transmitter zero at predetermined time intervals. The automatic zeroing circuit shall re-zero the transmitter to within 0.1 percent of true zero.
 - 6. Performance:
 - a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
 - b. Calibrated Span: Field adjustable, minus 40 percent of the range.
 - c. Accuracy: Within 0.25 percent of natural span.
 - d. Repeatability: Within 0.15 percent of calibrated span.
 - e. Linearity: Within 0.2 percent of calibrated span.
 - f. Hysteresis and Deadband (Combined): Less than 0.2 percent of calibrated span.
 - 7. Integral digital display for continuous indication of airflow.

2.6 CONTROL DAMPER ACTUATORS

A. General Requirements

1. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.
2. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
3. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
4. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.
5. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.
6. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.
7. Provide mounting hardware and linkages for connecting actuator to damper.
8. Select actuators to fail in desired position in the event of a power failure.

B. Type: Motor operated, with or without gears.

C. Construction:

1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Modulating Actuators:

1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:
 - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
 - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 4- to 20-mA signals.

F. Air Terminal Unit Damper Actuators:

1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:
 - a. Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.

G. Position Feedback:

1. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and closed position.
2. Where indicated, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

H. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

I. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

J. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

K. Temperature:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.

L. Enclosure:

1. Suitable for ambient conditions encountered by application.

2. NEMA 250, Type 2 for indoor and protected applications.
 3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
- M. Stroke Time:
1. Operate damper from fully closed to fully open within 60 seconds.
 2. Operate damper from fully open to fully closed within 60 seconds.
 3. Move damper to failed position within 30 seconds.
 4. Select operating speed to be compatible with equipment and system operation.
 5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

2.7 CURRENT SENSORS

- A. Binary Sensors: minimum 1 – 135 continuous amperage rating with trip setpoint adjustable to plus or minus 1 percent of range.
 1. Operating Parameters; 5 degrees F to 140 degrees F; Humidity 0 – 95 percent non-condensing.
 2. Output Signal: Solid state, NO contact closure, 0.1A at 30 VAC/Vdc
 3. Supply Voltage: self-induced from load being monitored.
- B. Analog Sensors: Minimum 0 – 200 continuous amperage rating with adjustable zero and span, frequency insensitive range between 10- 80 Hz to 1 percent of range, minimum response of 150 ms.
 1. Accuracy: 0.5 percent of full scale
 2. Output Signal 4-20 ma directly proportional to sensed amperage range.
 3. Supply Voltage: 12 – 30 Vdc, 30 mA maximum supply circuit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicatedFastening Hardware:
 - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
 - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
 - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- C. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 TEMPERATURE INSTRUMENT INSTALLATIONS

- A. Mounting Location:
 - 1. Roughing In:
 - 1. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
 - a. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
 - 1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
 - 2) Do not begin installation without submittal approval of mounting location.
 - b. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Architect on request.
 - 2. Install switches and transmitters for air and liquid temperature associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.
 - 3. Install liquid temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
 - 4. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
 - 5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to

accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Special Mounting Requirements:

1. Protect products installed outdoors from solar radiation, building and wind effect with stand-offs and shields constructed of Type 316 stainless.
2. Temperature instruments having performance impacted by temperature of mounting substrate shall be isolated with an insulating barrier located between instrument and substrate to eliminate effect. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.

C. Mounting Height:

1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
 2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.
- D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

E. Single-Point Duct Temperature Sensor Installation:

1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed 24 inches in sensor length.
2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
3. Rigidly support sensor to duct and seal penetration airtight.
4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.

3.4 FLOW INSTRUMENTS INSTALLATION

A. Airflow Sensors:

1. Install sensors in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.
2. Installed sensors shall be accessible for visual inspection and service. Install access door(s) in duct or equipment located upstream of sensor, to allow service personnel to hand clean sensors.

B. Transmitters:

1. Install airflow transmitters serving an air system in a single location adjacent to or within system control panel.
2. Install liquid flow transmitters, not integral to sensors, in vicinity of sensor. Where multiple

flow transmitters serving same system are located in same room, co-locate transmitters by system to provide service personnel a single and convenient location for inspection and service.

3.5 CONTROL VALVES

- A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.
- B. Install flanges or unions to allow drop-in and -out valve installation.
- C. Valve Orientation:
 1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
 2. Install valves in a position to allow full stem movement.
 3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.
- D. Clearance:
 1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
 2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.
- E. Threaded Valves:
 1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
 2. Align threads at point of assembly.
 3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
 4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.
- F. Flanged Valves:
 1. Align flange surfaces parallel.
 2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53

"Identification for Electrical Systems."

3.7 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
- B. Wash and shine glazing.
- C. Polish glossy surfaces to a clean shine.

3.8 CHECK-OUT PROCEDURES

- A. Check installed products before continuity tests, leak tests, and calibration.
- B. Check temperature instruments for proper location and accessibility.
- C. Verify sensing element type and proper material.
- D. Verify location and length.
- E. Verify that wiring is correct and secure.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform according to manufacturer's written instruction.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Prepare test and inspection reports.

3.11 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 250205

SECTION 250125 – BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide an expansion of the Airport's existing Building Automation System for control, monitoring, and energy management as specified and indicated on the Drawings.
- B. BAS manufacturer is responsible for all BAS design, installation, startup and testing. BAS design shall comply with the guidelines established in this Section.
- C. Furnish and install all control equipment necessary for a complete and operable system.
- D. Provide all BAS controls cabling for a complete and operable system. Any cabling to support an Internet Protocol (IP) connection to BAS equipment shall be coordinated with and installed by the Division 27 low voltage contractor. Cabling to support IP connections shall conform to all Division 27 requirements.
- E. Work of this section includes all electrical distribution except as noted below.
- F. Coordinate with other Divisions as required for interface with the BAS.
- G. Furnish all Terminal Unit Controllers.
- H. Interface this BAS expansion with the existing BAS system, including any new head-end equipment which the Airport may install during the project construction. .
- I. Provide system testing, including demonstration and systems integration testing.
- J. Related Sections:
 1. Section 250130 “BAS Interface Requirements”.
 2. Section 250205 “Field Devices for Building Automation System.”
 3. Section 271510 “Communications Horizontal Cabling”.
 4. Section 271310 “Communications Backbone Cabling”.

1.3 WORK BY OTHERS

- A. Division 26 shall provide power connections to BAS controlpanels.
- B. Division 23 shall install control valves, control dampers, sensor wells, differential pressure transmitter, air flow measuring stations, and other field devices in duct or piping systems.

- C. Division 23 TAB contractor to be present and assist with calibration of air flow measuring stations and flow meters.
- D. Division 27 shall provide Technet Data Communications Network connections to the BAS control panels.

1.4 TRADE CONTRACTOR QUALITY ASSURANCE

- A. The BAS system shall be designed and installed, commissioned and serviced by manufacturer employed, factory trained personnel.
- B. Materials and equipment shall be the catalogued products and shall be manufacturer's latest standard design that complies with the specification requirements. Material and equipment installed shall be new and unused.
- C. All equipment shall be compatible with the Owner's version of Siemens Enterprise Software.
- D. Installation shall be in conformance with the manufacturer's printed installation instructions.
- E. All BAS controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
- F. BAS components which are part of engineered smoke control systems, as noted on the Drawings, shall be rated for such use and be listed under UL 864, UUKL, PAZX.
- G. The manufacturer shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.
- H. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, governing radio Frequency Electromagnetic Interference and be so labeled.

1.5 SUBMITTALS

- A. Action Submittals
 - 1. Product Data for all components provided in the project.
 - 2. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.
 - 3. Project specific schematics, including:
 - a. Overall system architecture
 - b. Sequence of operations.

- c. Instrumentation diagrams
 - d. Points lists
 - e. Point names.
 - f. Point addresses.
 - g. Interface wiring diagrams.
 - h. Control Panel layouts.
 - i. System riser diagrams.
4. Floor plans showing:
 - a. Control panel locations
 - b. Terminal unit locations
 - c. Floor Level Network routing and identification.
 5. Interface Diagrams
 - a. For all equipment with BAS interface, provide diagrams showing:
 - 1) Equipment supplier's scope
 - 2) BAS scope
 - 3) Points to be integrated.
 - 4) Interface protocol.
 6. Screen Displays
 - a. Before creating screen displays submit color samples. Submit typical equipment, such as a single example of:
 - 1) Unit Heater
- B. Informational submittals
1. Provide copies of BAS QA/QC procedures to be used for system installation, startup and checkout. Procedures shall, as a minimum, include:
 - a. Controller installation.
 - b. Sensor installation, calibration and checkout.
 - c. Point-to-point wiring checkout.
 - d. Third-party interface validation.
 - e. Control loop verification.
 - f. Alarm verification.
- C. Closeout Submittals
1. Comply with the requirements of Division 1 for Operation and Maintenance manuals and with the following
 - a. Manufacturer's equipment parts list of all functional components of the system.
 - b. Electronic copies of system schematics, including wiring diagrams.
 - c. System schematics, including wiring diagrams.
 - d. Description of sequence of operations.

- e. As-built interconnection wiring diagrams.
- f. Operator's Manuals.
- g. Riser diagram showing panel locations and networking.
- h. List of connected data points, including panels to which they are connected and input device (occupancy sensors, push buttons, light sensors, etc).
- i. Conduit routing diagrams.
- j. Transformer and Breaker locations.
- k. Control program, point definitions, and all other setup information needed to replace the controller.
- l. Printout of supplied dynamic graphics displays.

1.6 WARRANTY

- A. Provide all service, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year after beneficial use or manufacturer's standard warranty, whichever is longer.
- B. The adjustment, required testing, and repair of the system includes all computer equipment, transmission, equipment and all sensors and control devices.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Siemens Industry, Inc. Building Technologies Division. All equipment shall be compatible with the latest version of Siemens Enterprise Software.

2.2 WIRING AND CABLES

- A. Low voltage cables including field device, network and signal cables shall comply with Division 27.
- B. All power wiring and related devices shall comply with Division 26.
- C. All power, field device and network wiring shall be in minimum of $\frac{3}{4}$ " conduit, except the final 12" of field device wiring.
- D. All wiring shall comply with project specifications, codes, and BAS manufacturer's published standard.

2.3 PROJECT DESIGN REQUIREMENTS

- 1. Panel enclosure shall be Siemens, UL listed, with hinged, lockable door. NEMA 1 for panels inside and NEMA 4X for panels outside or exposed to ambient air. Outdoor conduit fittings must be rated at NEMA 4X
- 2. Panel enclosure shall have sufficient space for 50% increase in I/O points.

- 3. All control wiring shall be routed through a gutter before entering control panel.
 - 4. Controller shall be PXCM or latest version of hardware controllers. Controller shall be supplied with the latest released version of firmware.
 - 5. Controller and I/O modules shall be provided with 10% spare points of each type (AI, AO, BI, BO)
 - 6. All digital and analog output modules shall include manual override feature.
 - 7. All analog modules shall include LCD display.
 - 8. Install transformers in a separate enclosure
 - 9. Provide permanent printed labels on each control panel. Label information shall include cabinet number designation, power feed information, instance ID, location, and serving AHU name.
 - 10. All terminal units shall be loaded with the latest firmware version that is currently in production. Verify that firmware is compatible with current Desigo software being used at the airport. All terminal units shall be set to an operational baud rate of 115200 and reside on a FLN configured to the same baud setting of 115200. All FLN pathways must meet the RS-485 (EIA-485/TIA-485) standard and adhere to the established best practices of this standard.
- B. Provide Control Panels for the following:
- 1 One component panel to support up to two BAS enclosure panels with a common gutter.
 - 2 One panel for each Air Handling Unit
 - 3 One Panel for each pump room.
 - 4 Other locations as required for monitoring and systems integration, including power and Technet connections.
- C. Terminal Unit Controllers shall be standard products as required for the sequences of operation. Terminal Unit Controllers with integral damper actuators are not allowed. Each controller shall be labeled with system name, address, transformer location, and circuit breaker number
- D. Provide one Terminal Unit Controller for each Fan Coil Unit and each Air Terminal Unit. Air Terminal Units shall be connected to a floor level network originating in the AHU control panel serving the terminal unit.
- E. All transformers required, shall be sized so that power load is no more then 50% of full load.
- F. Install transformers in a separate enclosure from the controllers. Transformer locations and devices served need to be clearly labeled on enclosure.
- G. Junction boxes shall be in an accessible location for troubleshooting.
- H. Surge transient protection shall be incorporated in design of system to protect electrical components in all DDC Controllers and operator's workstations.

PART 3 - EXECUTION

3.1 EXISTING CONTROL DEVICES

- A. Where work of this section includes interfacing with existing systems, Contractor shall assume that existing control devices are fully operational otherwise noted. Verify existing conditions and locations of devices and communications tie-ins before beginning the project.

3.2 SYSTEMS INTEGRATION

- A. The following specification sections include BAS interface for monitoring or control.
 1. 220520 "Meters and Gages for Plumbing Piping"
 2. 223500 "Electric Domestic Water Heaters"
 3. 260913 "Electrical Power Monitoring"
 4. 250944 "Relay-Based Lighting Controls"
 5. 263354 "Static Uninterruptable Power Supply"
 6. 263601 "Transfer Switches"
 7. 283111 "Digital Addressable Fire-Alarm System"
- B. Monitoring, including hardwired points, or control is further defined by equipment schedules, control diagrams, sequences and points lists in the drawings.

3.3 INSTALLATION

- A. All BAS equipment, conduit and other devise shall be located to provide adequate clearance for maintenance and shall not interfere with maintenance or code required clearances for other equipment.
- B. Any connection to the Owner's LAN or other system devices shall be connected to a termination outlet (wall jack, biscuit type jack, patch panel, etc.) on both ends of the connection via a Category 6a patch cable complying with specification 27 15 10 "Communications Horizontal Cabling". No field device shall be directly connected to an Owner's local area network switch or similar device.
- C. Provide all necessary copper and fiber patch cables for making all network switch interconnections to support the BAS including room-to-room cabling connections and from network equipment to in-room termination panel. The Contractor shall ensure that all patch cables meet patch cable requirements as specified in Section 27 15 10 Communication Horizontal Cabling. Any known cabling issues discovered during implementation shall be brought to the attention of the Owner.
- D. Coordinate with other Divisions so that application specific controllers have a minimum of 18" clearance from the controller face to any obstruction and that this service space can be accessed from below.
- E. All BAS conduit, including those for field devices and networks shall be labeled. Network conduit labels shall identify the specific network.

3.4 PROGRAMMING

- A. Provide necessary programming to implement the written sequences of operation.

3.5 ALARM MANAGEMENT

- A. System alarms are defined in the specifications and on the drawings.
- B. Each alarm shall be assigned an Alarm Level. The Alarm Levels are characterized as:
 - 1. Level 1: Life Safety / Security Critical Alerts
 - 2. Level 2: Life Safety / Security non-Critical Alerts
 - 3. Level 3: Critical Equipment Failure
 - 4. Level 4: Non-Critical Equipment Failure
 - 5. Level 5: Energy Conservation Alert
 - 6. Level 6: Maintenance Notification
- C. Alarm reports and messages shall be routed to a user-defined list of responsible groups.
- D. The alarm message text shall be used to describe the nature and location of the alarm, required response and contact information.
- E. Each alarm shall be individually resettable. In addition each system shall be capable of resetting all associated alarms with a single input.

3.6 DATA LOGGING

- A. Data logging and trending is described on the drawings. Points to be logged shall be recorded at the intervals given, for a period of one year. Data logs shall be easily retrievable, and shall be displayed in either tabular form or graph form.
- B. Logs shall include the equipment identification (EQUIPMENT NAMEPLATE), value recorded, units, date and time.

3.7 DYNAMIC COLOR GRAPHICS (SCREEN DISPLAYS)

- A. Contractor is responsible for updating Owner's screen displays with new graphics as required for this work
- B. Screen displays shall be hierarchical linked dynamic operator interface for displaying system data and for commanding and modifying equipment operation. The interface shall use pull-down menus, tool bar and dialog boxes.
- C. Screen displays shall include systems segregated by user groups. For each user group screens shall be provided for the complete project, showing the extent of this project, each building or area (such as parking lots), each floor and each room.
- D. User Groups are:
 - 1. Facilities Maintenance
 - 2. CUP / Boiler Plant

- 3. Plumbing / FM Coordination / 520
 - 4. Fire
 - 5. Control Center
 - 6. Electrical
 - 7. Lighting
 - 8. IT / Technical
 - 9. Airfield Glycol
 - 10. Environmental
 - 11. Finance
 - 12. Fire Training Facility (ARFF)
 - 13. Energy Conservation.
- E. Screen displays shall be provided for each system and piece of equipment monitored or controlled. Each piece of equipment shall show all associated points and alarms. All points shall be dynamic with continuously updated values.
- F. The Contractor shall develop, coordinate, and administer a series of workshops with BAS stakeholders to define, prototype and finalize the screen displays that will be provided with the system. At a minimum the contractor shall support three (3) workshops. These workshops shall include:
- 1. Initial workshop; Contractor shall provide a baseline prototype of the screen display and describe to the stakeholders the available options, fields, layouts, etc. During this workshop the stakeholders will provide input and direction to the desired layouts, fields to include, and other information required by the Contractor to develop the initial screen layouts. An appropriate number of specific screen displays shall be identified for further development.
 - a. Following the initial workshop, the contractor shall develop screen displays for further review by the stakeholders.
 - 2. Follow up workshop: Following the initial workshop, and after the development of preliminary screen displays, a follow up workshop will be conducted by the Contractor. The intent of the follow up workshop is to review the preliminary screen displays and for the stakeholders to provide comments and further input into the desired displays. The results of the follow up workshop will be to gather all required information and input to finalize the screen displays.
 - 3. Final workshop: The final workshop will be utilized to present the final screen displays and to obtain stakeholder acceptance for incorporation into the screen display submittals.

3.8 NAMING CONVENTIONS

- A. All BAS points and graphics shall incorporate naming conventions as defined by the Owner which are shown on drawings as "EQUIPMENT NAMEPLATE". This name shall be used for all system points, equipment identification on system graphics, point logs and other items.

3.9 SYSTEM START UP, CALIBRATION, AND SIGNOFF

- A. Contractor shall be responsible for start up, check out, and calibration for the BAS. All setpoints shall be input, and the system shall be operated and adjusted, as required, to provide satisfactory

operation as to the intent of the plans and specifications during the warranty period. Owner shall be notified before any start-up or calibration processes.

- B. The Contractor shall provide the labor and test apparatus required to calibrate and prepare for operation of all instruments, controls and accessory equipment furnished under this specification. This work includes; zero, span and calibration checks of all instruments, devices, equipment and accessories both field and panel mounted.
- C. The Contractor shall furnish labor and test apparatus required to check the operation of all control loops, setpoints and interlocks. After testing, the BAS operation shall be officially demonstrated to and accepted by the Owner. Contractor will be responsible for correcting any work unacceptable to the Owner
 - 1. Owner will select a number of systems to be demonstrated. For each system, all related equipment and sub-systems shall be tested.
 - 2. Demonstration testing shall include:
 - a. Each system point shall be tested for hardware and software functionality.
 - b. Each control loop shall be tested to verify the sequence of operation.
 - c. Alarm verification including alarm level and alarm clearing.
 - d. Graphics verification including displayed values, parameter updating.
- D. Systems integration testing: test each system for proper integration. Show that each point imported into the BAS is correctly displayed, the variables are correct and alarms functional. Test performed by contractor, witnessed by owner.
- E. The Contractor shall provide signoff forms for all operational testing to be accomplished under this contract. Sign off shall include verification of all changes made to the existing BAS, and for each item of mechanical, electrical, and instrumentation equipment provided or installed under this Contract, and shall contain provisions for recording relevant performance data for original testing and not less than 2 retests. Separate sections shall be provided to record values and for the initials of the Contractor and the Owner's representative.
- F. Provide Owner with a copy of commissioning data showing that each device is operating properly.
- G. Contractor shall demonstrate that equipment monitoring and system integration requirements are fully functional.
- H. Provide any recommendation for system modification in writing to the Owner. Do not make any system modification, including operating parameters and control settings, without prior approval of owner.

END OF SECTION 250125

SECTION 250130 – BAS INTERFACE REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section defines product requirements and documentation to be provided for devices which are a part of, or communicate with the Building Automation System (BAS) through a network connection.
- B. Related Requirements:
 1. Section 25 01 25 "Building Automation System"
 2. Section 27 15 10 "Communications Horizontal Cabling".
 3. Section 27 13 10 "Communications Backbone Cabling".

1.3 DEFINITIONS

- A. BAS: Building Automation System.
- B. BACnet Specific Definitions:
 1. BACnet: Building Automation Control Network Protocol, ANSI/ASHRAE 135.1. A communications protocol allowing devices to communicate data and services over a network.
 2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
 3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
 4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
 5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.
- C. BTL: BACnet Testing Laboratory.
- D. Device: any physical object that is controlled, monitored or otherwise communicates with the BAS.

- E. Gateway: Bidirectional protocol translator that connects control systems using different communication protocols.
- F. MODBUS/RTU: A serial data communication protocol.
- G. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- H. Peer to Peer: Networking architecture that treats all network stations as equal partners.
- I. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- J. Third-Party Device: A device not manufactured specifically for or manufactured by a supplier.

1.4 PRODUCT REQUIREMENTS

- A. Any system or device which is part of, connected to, monitored by or communicates with the BAS through a network connection must use either MODBUS or BACnet protocol. All cabling required to support the network connection shall be installed in accordance with Division 27 requirements.
- B. BACnet Requirements
 - 1. BACnet systems or devices must be certified by BTL and must carry a “BTL Mark” signifying compliance with ANSI/ASHRAE 135.1.
 - 2. All systems and devices shall use BACnet/IP or MSTP protocol.
 - 3. Devices shall communicate peer-to-peer with other devices.
 - 4. Devices shall be able to use local broadcasts received by all peer devices on the network.
 - 5. Devices shall be able to send remote broadcasts to devices residing on networks having different network numbers.
 - 6. Devices shall be capable of data sharing to include BACnet priority, change of value, trending, scheduling, alarm/event management, device and network management.
 - 7. Devices shall conform to the BACnet PICS.
 - 8. All devices shall be certified, listed and stamped by the BTL.
- C. MODBUS Requirements:
 - 1. Devices shall adhere to MODBUS TCP/IP or MODBUS RTU protocol.
 - 2. Devices shall follow the client/server model for communication between devices. The client initiates the transaction, the server responds to complete the transaction.
 - 3. Devices which translate any protocol to MODBUS shall not be used.
- D. Gateways shall not be used.

1.5 SUBMITTALS

- A. Action Submittals

BAS INTERFACE REQUIREMENTS

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1. Product Data: For each type of product demonstrating compliance with this specification including the following:
 - a. Product description with complete technical data and product specification sheets.
 - b. Installation, operation and maintenance instructions.
 - c. BACnet specific information:
 - 1) PICS data sheet.
 - 2) BIBB document.
 - 3) Functional Specification Document (FSD) describing how the device will provide the specified BAS interface.
 - d. MODBUS specific information:
 - 1) Configuration guide including a register of all system points.
- B. Informational Submittals:
 1. Data Communications Protocol Certificates: Certifying that each proposed BACnet system component complies with ASHRAE 135.

1.6 TRADE CONTRACTOR'S QUALITY ASSURANCE

- A. MODBUS devices shall be installed, configured, and programmed by technicians or application engineers certified by the manufacturer for MODBUS products.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 INTEGRATION RESPONSIBILITIES

- A. BAS responsibility for systems integration:
 1. Provide the necessary server and software to act as a BACnet or Modbus client.
 2. Verify that the Source device is communicating with the BAS.
 3. Configure all points provided by the third-party system (Source) as BACnet or Modbus objects.
 4. Represent the integrated points on BAS graphics.
 5. Display and update objects, including alarms, using COV or polling mechanism of the Source. Data will be represented as received from the Source. No additional processing will be performed.
 6. Provide Source with necessary addressing and network information for Source

BAS INTERFACE REQUIREMENTS

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programming.

- B. Third-party (Source) responsibility for systems integration:
 - 1. Program intrinsic reporting of alarms and events as Notification Class objects.
 - 2. Provide Device ID, Name, Object ID, Object Type, Description and other parameters as a electronic file of the proper type.
 - 3. Install source communication device and configure settings to communicate with the BAS.
 - 4. Program Device ID, Port Numbers, and Network Numbers into Source device, based on information provided by BAS.
 - 5. Program IP addresses into all Source IP devices.
 - 6. Provide BACnet PICS or equivalent Modbus information for Source.
 - 7. Provide necessary Source equipment.
 - 8. Verify that the Source device is communicating with the BAS.
 - 9. Provide support for integration, startup, testing and commissioning.
 - 10. Coordinate with Division 27 contractor to provide all horizontal cabling for any BAS device that requires an Internet Protocol (IP) network connection. All horizontal cabling shall be installed in accordance with Division 27 specification requirements.

3.2 ACCEPTANCE TESTING

- A. Acceptance testing for any system or equipment with network connection to BAS shall include demonstrating that all points required by the contract documents are properly originated (by the Source or BAS) and received (by the BAS or Source).
- B. Systems or equipment will not be accepted until the network communication is functional.

END OF SECTION 250130

SECTION 260080 – ELECTRICAL DEMOLITION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to electrical demolition.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical demolition work is indicated by drawings.
- B. Electrical demolition items are shown to give a basic description of the extent of demolition work, but may not be inclusive.
- C. Do not assume that the electrical drawings reflect as-built conditions. Visit and observe the project prior to submitting bid and determine extent of electrical demolition work.

1.3 QUALITY ASSURANCE:

- A. Standards: Refer to Section 260001 - Electrical General Provisions as applicable.

PART 2 – PRODUCTS - Not Used.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Demolition work shall be laid out in advance to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary, perform with care, use skilled mechanics of the trades involved. Cutting work of other contractors shall be done only with the consent of that contractor. Cutting of structural members is not permitted. Repair damage to building and equipment as a result of electrical demolition work under this contract at no additional cost to owner.

- B. Obtain permission from the architect before penetrating any ceiling, floor, and wall surfaces.

3.2 METHODS:

- A. Disconnect and remove any/all fixtures, devices, equipment, etc. required for proper completion

- of the work whether shown or not.
- B. Relocate, rewire, and/or reconnect any/all fixtures, devices, equipment, etc. that for any reason obstructs construction.
 - C. Maintain circuit integrity and continuity of all existing circuits/feeders, and systems that interfere with or are interrupted by remodel work, unless those circuits/feeders are to be abandoned completely. Maintain all circuits and systems in operation during construction. Provide temporary panels, temporary wiring and conduits, etc. as required.
 - D. Leave all existing fixtures, devices, equipment, etc. In portions of the building not being remodeled, in working condition.
 - E. Remove and dispose of all raceways, conductors, boxes, devices, equipment, etc., that are not to be reused. Terminate at accessible junction box by providing proper knockout closure, tape conductors, and label as "spare" with circuit no., Zone no., or other characteristic identifying source.
 - F. Existing raceways may be reused, if in place, where in compliance with the contract documents and the National Electrical Code. Upgrade and/or provide new conduit supports where necessary for all raceways being reused. Insure integrity of existing raceways before re-use.
 - G. Existing raceways may not be reused. Completely remove all existing raceway that are not to remain back to source.
 - H. Return to owner all light fixtures which are to be removed. Dispose of all light fixtures if so directed by owner in accordance with local environmental laws and policies. Those fixtures indicated for re-use shall be thoroughly cleaned, repaired as required, re-lamped, and installed as indicated. When storing fixtures for reuse, store in area and/or provide protective covering that will keep construction dust and materials off fixtures.
 - I. Completely remove all telephone or data cables which are to be removed back to source or as directed by owner.
 - J. Disconnect and remove all sound system equipment including speakers, amplifiers, etc. And return to owner. Completely remove and dispose of all associated conduit and wire.

3.3 PATCHING AND REPAIR:

- A. Finished Surfaces: The electrical contractor is responsible for patching and repair of all existing interior surfaces pertaining to the installation of work under this Division, unless specifically noted elsewhere in the contract documents. Where patching and repair is necessary, surfaces shall be finished (painted, etc.) to match the adjacent materials, finished, and colors. Requirements of other Divisions such as Division 9 - finishes shall apply.
- B. Hard Surfaces: Whenever excavation or trenching is required for the installation of electrical work, it shall be the responsibility of the electrical contractor to make repairs and/or replacements of hard finish surfaces such as concrete, asphalt, etc. Requirements of other Divisions such as Division 2 – Existing Conditions shall apply.

3.4 CONCEALING:

- A. All raceways shall be concealed within the ceilings, walls, and floors, except in locations where exposed raceways are specifically permitted, such as equipment rooms and unfinished storage areas.
- B. Surface-mounted raceways or systems shall be permitted only where approved by Architect/Engineer.

END OF SECTION 260080

SECTION 260520 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A.** Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

- B.** Prohibited Materials:

1. Armored cable, Type AC.
2. Metal-clad cable, Type MC.
3. Aluminum conductors

1.3 DEFINITIONS

- A.** IECA: Insulated Cable Engineers Association.
- B.** NETA: National Electrical Testing Association.
- C.** NEMA: National Electrical Manufacturers Association.
- D.** NFPA: National Fire Protection Association.
- E.** NRTL: Nationally Recognized Testing Laboratory.
- F.** VFC: Variable frequency controller.

1.4 SUBMITTALS

- A.** Action Submittals:

1. Product Data: For each type of product.

- B.** Response to specifications:

1. The Contractor and manufacturer shall submit a point by point statement of compliance with the specifications.
 2. The statement of compliance shall consist of numbered paragraphs. Each specification paragraph shall be cross referenced to the page/drawing in the submittal on which the compliance is confirmed. The confirming data on the page/drawing shall be highlighted for ready identification.
 3. Where the proposed system complies fully, indicate by placing the word "comply" next to the subparagraph.
 4. Where the proposed system does not comply, or accomplishes the stated function in a manner different from that described, provide a full description of the deviation.
 5. A submittal which does not include a point by point statement of compliance as specified shall be rejected.
- C. Substitutions. Submit request for substitution of materials as part of product submittal, in accordance with the requirements of Division 01.
- D. Informational Submittals:
1. Qualification Data: For testing agency.
 2. Field quality-control reports.

1.5 TRADE CONTRACTOR'S QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member Company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alpha Wire Company.
 2. Belden Inc.
 3. Cerro Wire LLC.
 4. Encore Wire Corporation.
 5. General Cable; General Cable Corporation.
 6. Senator Wire & Cable Company.
 7. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70 / ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70 / ICEA S-95-658 for Type THHN/THWN-2 and Type XHHW-2.

- D. Multi-conductor Cable: Comply with NEMA WC 70 / ICEA S-95-658 for Type SO with ground wire.
- E. STOW Cable: 600volt insulation and minimum No.12 conductors.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M.
 - 2. AFC Cable Systems, Inc.
 - 3. Gardner Bender.
 - 4. Hubbell Power Systems, Inc.
 - 5. Ideal Industries, Inc.
 - 6. ILSCO.
 - 7. NSi Industries LLC.
 - 8. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 9. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Provide conductors in sizes shown on the plans and as specified below.
- B. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTI-CONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Provide insulation type as specified below, color-coded as specified in Section 260554 "Identification for Electrical Systems."
- B. Service Entrance: Type XHHW-2. All shall be single conductors in raceway.
- C. Exposed Feeders: Type THHN/THWN-2 for No. 1 AWG and smaller; Type XHHW-2 for No. 1/0 AWG and larger. All shall be single conductors in raceway.
- D. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2 for No. 1 AWG and smaller; Type XHHW-2 for No. 1/0 AWG and larger. All shall be single conductors in raceway.
- E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2. All shall be single conductors in raceway.
- F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway for No. 1 AWG and smaller; Type XHHW-2, single conductors for No. 1/0 AWG and larger.
- G. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2 for No. 1 AWG and smaller; Type XHHW-2 for No. 1/0 AWG and larger. All shall be single conductors in raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2 for No. 1 AWG and smaller; Type XHHW-2 for No. 1/0 AWG and larger. All shall be single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-
- J. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway for No. 1 AWG and smaller; Type XHHW-2, single conductors for No. 1/0 AWG and larger; Multi-conductor, PVC-sheathed Tray Cable, Type TC.
- K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- L. STOW Cable: Can only be used for the wiring of chain/cable hung light fixtures in open areas without ceiling between junction box and fixture; for wiring of undercabinet lights as indicated on the details on the drawings and for wiring between the apron (high mast poles) light fixtures through the pole to the pole handhole.
- M. VFC Output Circuits: Type XHHW-2 in metal conduit.

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 according to

Section 260534 "Raceways and Boxes 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 260530 "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 un-spliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260554 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

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 260545 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

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

3.8 TRADE CONTRACTOR'S QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Cables will be considered defective if they do not pass tests and inspections. All defective cables shall be replaced at the Contractor's expense.

3.9 OWNER'S QUALITY ASSURANCE

- A. Owner's independent commissioning and witnessing agency will provide the following witnessing and/or review services:
 - 1. Witness all infrared scanning.
 - 2. Review all test and inspection reports.

END OF SECTION 260520

SECTION 260527 - GROUNDING AND BONDING FOR ELECTRICAL

SYSTEMS PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment, plus the following special applications:
 1. Underground distribution grounding.
 2. Ground bonding common with lightning protection system.
 3. Foundation steel electrodes.

1.3 SUBMITTALS

- A. Action Submittals:
 1. Product Data: For each type of product indicated.
- B. Informational Submittals
 1. Qualification Data: For testing agency and testing agency's field supervisor.
 2. Field quality-control reports.
 - a. Test procedures and testing equipment used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - C. Closeout Submittals
 1. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - a. Test wells.
 - b. Ground rods.
 - c. Ground rings.
 - d. Grounding arrangements and connections for separately derived systems.
 2. Operation and Maintenance Data: For grounding to include in emergency, operation,

and maintenance manuals.

- a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1) Instructions for periodic testing and inspection of grounding features at test wells based on NFPA 70B.
 - a) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - b) Include recommended testing intervals.

1.4 TRADE CONTRACTOR'S QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Certified by NETA or NICET to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Burndy; Part of Hubbell Electrical Systems.
 2. ERICO International Corporation.
 3. Fushi Copperweld Inc.
 4. Galvan Industries, Inc.; Electrical Products Division, LLC.
 5. Harger Lightning & Grounding.
 6. ILSCO.
 7. O-Z/Gedney; a brand of Emerson Industrial Automation.
 8. Thomas & Betts Corporation, a Member of the ABB Group.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, minimum 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Larger bus shall be provided if needed to terminate the required quantity of conductors. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods:
 1. Material: Stainless steel.
 2. Diameter: 3/4 inch (19 mm).
 3. Rods shall be not less than 120 inches (3050 mm) long.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in all electrical equipment rooms-and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated. Final location of grounding bus shall be coordinated with final locations of electrical equipment in the electrical rooms.
 - 2. Grounding bus shall be installed exposed on wall.
 - 3. Refer to drawings for additional requirements.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground bus. Locate main bonding jumper at service entrance equipment for testing purposes.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers, Switches and Utility Vaults: Ground per Rocky Mountain Power Company standards.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Baggage X-Ray and/or Scanning Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying scanning equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
 - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. 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 a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment

- shutoff valve.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, unless otherwise indicated on drawings, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches (600 mm) from building's foundation, and at a depth of 24-30 inches.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
1. Coordinate location of Ufer Ground with concrete installer to ensure there is no vapor barrier or other non-conductive materials between the concrete and the earth in the location of the Ufer Ground.
 2. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 3. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.7 TRADE CONTRACTOR'S QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-

rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 - 5. Substations and Pad-Mounted Equipment: 5 ohms.
 - 6. Vault Grounds: 5 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.8 OWNER'S QUALITY ASSURANCE

- A. Owner's independent commissioning and witnessing agency will provide the following witnessing and/or review services:
 - 1. Witness all grounding tests for completed system, at locations indicated above.
 - 2. Review all grounding test and inspection reports.

END OF SECTION 260527

SECTION 260530 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.
3. Embeds

- B. Related Sections include the following:

1. Section 260549 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.
2. Section 014600 "Seismic Design Requirements for Nonstructural Systems"
3. Section 077200 "Roof Accessories"
4. Section 055000 "Metal Fabrications"
5. Section 033010 "Cast-in-Place Concrete"
6. Section 036510 "Post-Installed Anchors"

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Performance Based Design: Design equipment supports, including comprehensive engineering analysis by a qualified professional engineer licensed in the state of Utah, capable of withstanding the effects of gravity and seismic loads in accordance with the 2012 IBC. Gravity loading shall include the combined operating weight of supported equipment and connected systems and

components. Review structural drawings for attachments and load limits to primary structure. See Section 014600 "Seismic Design Requirements for Nonstructural Systems." Obtain approval from authorities having jurisdiction.

- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads required for this Project by applicable Code.

1.5 SUBMITTALS

A. Action Submittals

1. Product data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.
2. Performance Based Design Submittal: Signed and sealed by a qualified professional engineer registered in the state of Utah. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - a. Trapeze hangers.
 - b. Metal framing systems.
 - c. Equipment supports.
3. Submit an electronic file in format able to be scaled and combined with other similar files, of the bracing and hanging point loads to the Structural Engineer of Record for review. The point loads shall indicate magnitude, direction, type of load (dead, live, seismic, etc.) and be keyed to the method of attachment details.

B. Response to specifications:

1. The Contractor and manufacturer shall submit a point by point statement of compliance with the specifications.
2. The statement of compliance shall consist of numbered paragraphs. Each specification paragraph shall be cross referenced to the page/drawing in the submittal on which the compliance is confirmed. The confirming data on the page/drawing shall be highlighted for ready identification.
3. Where the proposed system complies fully, indicate by placing the word "comply" next to the subparagraph.
4. Where the proposed system does not comply, or accomplishes the stated function in a manner different from that described, provide a full description of the deviation.
5. Each sheet of the submittal shall be sequentially numbered in the form of "Sheet x of y" where "x" is the sequential number of the sheet and "y" is the total number of the sheets in the submittal.
6. A submittal which does not include a point by point statement of compliance as specified shall be rejected.

C. Information Submittals

1. Qualification Data: For professional engineer.
2. Welding certificates.

1.6 TRADE CONTRACTOR'S QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a Nationally Recognized Testing Laboratory as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Coordinate anchor bolt type and method of installation. Concrete, reinforcement, and formwork requirements are indicated on the drawings.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. Flex-Strut Inc.
 - e. GS Metals Corp.
 - f. G-Strut.
 - g. Haydon Corporation.
 - h. Metal Ties Innovation.
 - i. Thomas & Betts Corporation, a Member of the ABB Group.
 - j. Unistrut; an Atkore International company.
 - k. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA- 4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

- 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
- 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. G-Strut.
 - e. Haydon Corporation.
 - f. Seasafe, Inc.; AMICO, a Gibraltar Industries Company.
 - 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 3. Fitting and Accessory Materials: Same as channels and angles.
 - 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. 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.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Power-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. Refer to Section 036510 "Post-Installed Anchors" for additional requirements.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used. Refer to Section 036510 "Post- Installed Anchors" for additional requirements.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Cast in Place, Internally Threaded Embeds: Anchors are cast into the underside of

- concrete deck after being fastened to the top of wood forms or metal deck.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Caddy / Erico
 - 2) Powers Fasteners
 - 3) Simpson Strong-Tie Company Inc.
 - 5. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 6. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 7. Toggle Bolts: All-steel springhead type.
 - 8. Hanger Rods:
 - a. Interior - threaded carbon steel.
 - b. Exterior - zinc coated, threaded carbon steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
 - 2. Arrange steel slotted support channels to support conduit, raceway, and cables from the bottom. Install conduit, raceway, and cables on the top or upper surface of steel slotted support channels.
 - 3. Where multiple rows or layers of conduit, raceway, and cables are indicated or proposed for installation on common trapeze-type supports, size steel slotted support channels and associated hanger rods, fasteners, and hardware to support the combined

- final proposed load, with at least 25 percent future capacity without exceeding specified design load limits.
- D. 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 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten 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 or concrete embeds.
 3. To Masonry Embedded Anchors: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 - a. Instead of expansion anchors, power-actuated driven threaded studs provided with lock washers and nuts may be used in accordance with Section 036510 "Post- Installed Anchors".
 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars, post-tension cables, mechanical piping, etc. in concrete slabs.
- E. Do not use post-installed anchors or fasteners in post-tensioned slabs and beams without prior approval from the Engineer. Raceways shall be supported via attachment to concrete inserts.
- F. Electrical devices that are attached or are semi-recessed at a fire rated wall shall be mounted in such a way to not compromise the integrity of the rating and shall be connected in strict compliance with building codes. 1. Coordinate electrical work with Division 07, Fireproofing and Firestopping, to identify fire-rated walls and assemblies in the building.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) wider on each side of equipment, and so anchors will be a minimum of 10 bolt diameters from edge of the base. Concrete bases to be constructed flat on top when checked with a straight edge.
- B. Use normal weight concrete, 3000-psi (20.7-MPa) minimum, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033010 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing- repair paint to comply with ASTM A 780.

3.6 OWNER'S QUALITY ASSURANCE

- A. Owner's independent commissioning and witnessing agency will provide the following inspection services:
 - 1. Perform Special Inspections per Section 036510 "Post-Installed Anchors."

END OF SECTION 260530

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

260530 - 8

**SLCDA – DOCK 3 DOOR REPLACEMENT
GSBS PROJECT. NO. 2022.046.02**

SECTION 260534 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, vaults, and underground utility construction.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. EMT: Electrical metallic tubing.
- C. FMC: Flexible metal conduit.
- D. GRC: Galvanized rigid steel conduit.
- E. RNC: Rigid Nonmetallic Conduit
- F. IMC: Intermediate metal conduit.
- G. LFMC: Liquid-tight flexible metal conduit.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

2. Shop Drawings:
 - a. For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
 - b. For boxes at exterior CMU walls: Include plans, elevations, sections and attachment details, drawn to scale on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1) Structural members and wall components in vicinity of boxes and associated raceway, with individual or common supports. Coordinate box and raceway with hollow CMU cells, avoiding filled VMU cells and stell reinforcing bar embedded in CMU walls.
 - 2) HVAC and plumbing items and architectural features in vicinity of boxes and associated raceway, with individual or common support.
 - 3) Where grouped, align boxes vertically and horizontally on exterior walls for uniform height and spacing. Coordinate box locations with loads and equipment served. Boxes shall be considered grouped where located within 24 inches horizontally or vertically from adjacent boxes.
 3. Samples: For wireways and surface raceways and for each color and texture specified, 12 inches (300 mm) long.
- B. Informational Submittals:
 1. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - a. Structural members in paths of conduit groups with common supports.
 - b. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
 2. Qualification Data: For professional engineer.
 3. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - d. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
 4. Source quality-control reports.

1.5 TRADE CONTRACTOR'S QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated

1.6 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify OAR no fewer than seven days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without OAR's written permission.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Tube & Conduit; a part of Atkore International.
 2. Anamet Electrical, Inc.
 3. Electri-Flex Company.
 4. FSR Inc.
 5. O-Z/Gedney; a brand of Emerson Industrial Automation.
 6. Republic Conduit.
 7. Robroy Industries.
 8. Southwire Company.
 9. Western Tube and Conduit Corporation.
 10. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.
 3. Arnco Corporation.
 4. CANTEX INC.
 5. CertainTeed Corporation.
 6. Electri-Flex Company.
 7. Kraloy.
 8. RACO; Hubbell.
 9. Spiraduct/AFC Cable Systems, Inc.
 10. Thomas & Betts Corporation, a Member of the ABB Group.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ENT: Comply with NEMA TC 13 and UL 1653.
- D. RNC: Type EPC-80-PVC, complying with NEMA TC 2 and UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.
- E. LFNC: Comply with UL 1660.
- F. Rigid HDPE: Comply with UL 651A.
- G. Continuous HDPE: Comply with UL 651B.

- H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- I. RTRC: Comply with UL 1684A and NEMA TC 14.
- J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- K. Fittings for LFNC: Comply with UL 514B.
- L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- M. Solvent cements and adhesive primers shall comply with the testing and product requirements of the Utah Administration Code, Rule 307-342.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. MonoSystems, Inc.
 - 4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Moulded Products, Inc.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Lamson & Sessions.
 - 4. Niedax Inc.

- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent cements and adhesive primers shall comply with the testing and product requirements of the Utah Administration Code, Rule 307-342.

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. MonoSystems, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated.
 - b. MonoSystems, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Technologies Company.
 2. EGS/Appleton Electric.
 3. Erickson Electrical Equipment Company.
 4. Hoffman; a brand of Pentair Equipment Protection.
 5. Hubbell Incorporated.
 6. Kraloy.
 7. O-Z/Gedney; a brand of Emerson Industrial Automation.
 8. RACO; Hubbell.
 9. Robroy Industries.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- L. Gangable boxes are allowed.

- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.
 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC, IMC, RNC, Type EPC-80-PVC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, Type EPC-80-PVC, concrete encased.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed conduit, installed above 72 inches above finished floor and not subject to physical damage: EMT.
 2. Exposed conduit installed at or below 72 inches above finished floor, or otherwise subject to physical damage: GRC. In electrical and mechanical equipment rooms, EMT conduit may be routed down from above to specific equipment located within the 72" zone, provided the equipment provides some protection for the conduit.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. Damp or Wet Locations: EMT in damp locations and GRC in wet locations.
 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in kitchens and damp or wet indoor locations and Type 4X in all outdoor locations.
- C. Minimum Raceway Size:

- 1. Above grade: 3/4-inch trade size.
 - 2. Below slab-on-grade or below grade: 1-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
- 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use compression, fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).
- I. Do not anchor, attach, or connect framing, supports, connecting rods, support wires, boxes, and similar components and devices on or in fire-rated walls and assemblies. Anchors, bolts, shims, and similar components shall not penetrate or otherwise compromise the integrity of fire-rated walls and assemblies.
 - 1. Where luminaire fixtures, wiring devices, sensors, raceway, conduit, disconnects, controllers, and similar components and devices are indicated or shown in proximity to fire-rated walls and assemblies, provide metal framing or similar supports to span across and support the fixtures, devices, and components without attachment to or support from the fire-rated walls and assemblies. Refer to Section 26 05 30, "Hangers and Supports for Electrical Systems."
 - 2. Coordinate electrical work with Division 07, Fireproofing and Firestopping, to identify fire-rated walls and assemblies in the building.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260530 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of four 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. On CMU walls in mechanical, electrical and IT rooms conduits maybe routed exposed along CMU walls. Under no circumstances shall conduits along CMU walls in any other space be routed exposed.
- I. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- J. Raceways Embedded in Slabs Except for Suspended Slabs:
 - 1. Run conduit parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Structural Engineer for each specific location.
 - 5. Change from EMT to GRC or IMC before rising above floor.
 - 6. Install conduits as close as practical to the middle of the slab. Do not install conduits of diameter greater than 1/3 of the slab thickness. Space conduits not less than 3 diameters on centers, except at stub-up locations.
 - 7. Under no circumstances shall conduits and/or boxes be installed in suspended slabs.
- K. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or GRC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets.
- P. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- U. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
 - 4. Install conduit penetrations of building walls as specified in Section 260545 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Y. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground GRC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints, and at other locations where building movement, shifting, or settling is anticipated. Example: tunnel connections to existing structures.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed, semi-recessed, suspended, and chain mounted luminaire fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- AA. 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.
- BB. 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 rain-tight connection between box and cover plate or supported equipment and box.
- CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

- DD. Locate boxes so that cover or plate will not span different building finishes.
- EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- GG. Set metal floor boxes level and flush with finished floor surface.
- HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

II. Junction/Pull boxes, Gutters and Wireway Accessibility:

- 1. General requirements:
 - a. A minimum of 12" of clear space shall be provided in front (cover side) of all junction box/pull boxes, gutters, and wireways sized 4" x 4" x 4" and larger.
 - b. A minimum of 6" of clear space shall be provided in front (cover side) of all junction box/pull boxes sized smaller than 4" x 4" x 4".
 - c. All junction/pull boxes, gutters, and wireways shall be readily visible from floor level.
- 2. All junction/pull boxes, gutters, and wireways installed above lay-in ceilings shall be located so as to ensure greatest accessibility:
 - a. Junction/pull boxes used for branch circuiting and other similar applications shall be located within 36" of the lay-in ceiling.
 - b. Larger junction/pull boxes, gutters, and wireways used mainly for power distribution and panel feeders or similar type applications may be mounted higher provided that they are readily visible from floor level and there is sufficient access to allow for means to gain access to the boxes without having to crawl around obstructions.
- 3. All junction/pull boxes, gutters, and wireways installed above hard ceilings shall be located within 24" both horizontally and vertically from an access panel and shall not be obstructed by other systems:
- 4. All junction/pull boxes, gutters, and wireways installed in open exposed ceilings shall be located so as to ensure greatest accessibility:
 - a. Junction/pull boxes used for branch circuiting and other similar applications shall be located within 36" above the defined clear space.
 - b. Larger junction/pull boxes, gutters, and wireways used mainly for power distribution and panel feeders or similar type applications may be mounted higher provided that they are readily visible from floor level and there is sufficient access to allow for means to gain access to the boxes without having to crawl around obstructions.

3.3 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 260545 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260534

SECTION 260548 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchors (Epoxy anchors).

- B. Related Requirements:

1. Section 260530 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.
2. Section 014600 "Seismic Design Requirements for Nonstructural Systems"
3. Section 036510 "Post-Installed Anchor"

1.3 DEFINITIONS

- A. IBC: International Building Code, 2012 edition.
- B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance Based Design: Design seismic restraints and supports, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Utah, using performance requirements and design criteria indicated. Review structural drawings for attachments and load limits to primary structure. See Section 014600 "Seismic Design Requirements for Nonstructural Systems." Obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. ACTION SUBMITTALS

1. Product Data: For each type of product.
 - a. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component required.
 - 1) Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or other evaluation service agency acceptable to authorities having jurisdiction.
 - 2) Annotate to indicate application of each product submitted and compliance with requirements.
2. Shop Drawings:
 - a. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Performance Based Design Submittal: For each seismic-restraint device.
 - a. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by a qualified professional engineer registered in the state of Utah.
 - b. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, seismic and wind forces required to select seismic and wind restraints and for designing vibration isolation bases.
 - 1) Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - c. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
 - d. Seismic and Wind Restraint Details:
 - 1) Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - 2) Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their capacities, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - 3) Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - e. Submit an electronic file in a format able to be scaled and combined with other similar files, of the bracing and hanging point loads to the Structural Engineer of Record for review. The point loads shall indicate magnitude, direction, type of load (dead, live, seismic, etc) and be keyed to the method of attachment details.

B. Response to specifications:

1. The Contractor and manufacturer shall submit a point by point statement of compliance with the specifications.
 2. The statement of compliance shall consist of numbered paragraphs. Each specification paragraph shall be cross referenced to the page/drawing in the submittal on which the compliance is confirmed. The confirming data on the page/drawing shall be highlighted for ready identification.
 3. Where the proposed system complies fully, indicate by placing the word "comply" next to the subparagraph.
 4. Where the proposed system does not comply, or accomplishes the stated function in a manner different from that described, provide a full description of the deviation.
 5. Each sheet of the submittal shall be sequentially numbered in the form of "Sheet x of y" where "x" is the sequential number of the sheet and "y" is the total number of the sheets in the submittal.
 6. A submittal which does not include a point by point statement of compliance as specified shall be rejected.
- C. Informational Submittals:
1. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
 2. Qualification Data: For professional engineer.
 3. Welding certificates.
 4. Field quality-control reports.

1.6 TRADE CONTRACTOR'S QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a Nationally Recognized Testing Laboratory as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval by ICC-ES or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a professional engineer registered in the state of Utah.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

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2.1 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
1. Refer to Section 014600 "Seismic Requirements for Nonstructural Systems".
 2. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or other evaluation service agency acceptable to authorities having jurisdiction.
 - a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be in accordance with the IBC 2012.

2.2 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Hilti, Inc.
 3. Mason Industries, Inc.
 4. Unistrut; an Atkore International company.
- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Kinetics Noise Control, Inc.
 2. Loos & Co., Inc.
 3. Vibration Mountings & Controls, Inc.
- B. Restraint Cables: ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Kinetics Noise Control, Inc.

- 3. Mason Industries, Inc.
- 4. TOLCO; a brand of NIBCO INC.
- B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Refer to Section 035610 "Post-Installed Anchors". Provide zinc-coated steel anchors for interior applications and stainless steel for exterior applications. Select anchor bolts and embedment depths for strength required for anchor design loads and attachment substrate.

2.6 ADHESIVE ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
- B. Adhesive Anchors: Refer to Section 035610 "Post-Installed Anchors". Provide anchors and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor design loads and attachment substrate and compatible with selected adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and approved by OAR.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or other evaluation service agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.
- D. Luminaire Fixtures: Provide seismic and sway bracing to limit sway, swing, and motion of luminaire fixtures to prevent damage to fixtures and adjacent components, systems, finishes, and materials. Where bracing from structure above is insufficient to limit motion and prevent contact or impact, brace luminaire fixtures from adjacent structure and components. Use braces, brackets, and supports designed and listed for the application.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete" Or 033015 "Cast-in-Place Concrete - Parking Garage."
- B. Equipment and Hanger Restraints:
 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or other evaluation service agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at top flanges of beams, at upper truss chords of open web joists, or at concrete members.
- H. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Expansion Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened. Install in accordance with evaluation reports and the manufacturer's written instructions.
 - 4. Adhesive Anchors: Prepare substrate and install in accordance with evaluation reports and the manufacturer's written instructions.
 - 5. Refer to Section 036510 "Post-Installed Anchors" for additional requirements.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications and wet locations.
- I. Do not use post-installed anchors or fasteners in post tensioned slabs and beams. Raceways shall be supported via attachment to concrete insert.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, and wireways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment. Comply with requirements in section 014600 "Seismic Requirement for Nonstructural Systems."

3.5 TRADE CONTRACTOR'S QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with OAR, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide

- temporary load-spreading members.
4. Test anchors in accordance with the requirements listed in Section 036510 "Post-Installed Anchors."
 5. For anchors not covered by Section 036510 "Post-Installed Anchors," test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - a. Test to 90 percent of rated proof load of device.
- B. Seismic controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 OWNER'S QUALITY ASSURANCE

- A. Owner's independent commissioning and witnessing agency will provide the following inspections and/or review services:
 1. Perform Special Inspections per Section 036510 "Post-Installed Anchors."
 2. Review test and inspection reports.

3.7 ADJUSTING

- A. Coordinate and adjust seismic restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

SECTION 260554 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.
8. Identification for fire alarm system and devices.

1.3 SUBMITTALS

- A. Action Submittals:

1. Product Data: For each electrical identification product indicated.
2. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
3. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 TRADE CONTRACTOR'S QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.
- E. Coordinate with Owner's existing numbering / labeling system.
- F. Coordinate identification requirements for Division 28 fire alarm devices with Section 283111 "Digital, Addressable Fire Alarm Systems".

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Refer to drawings for backgrounds and letters colors.
 - 2. Legend: Indicate voltage, system and service type.
- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-

resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for mechanical fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)." or as otherwise indicated and/or required.
 - 3. Arc Flash Warning: "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - a. Location designation.
 - b. Nominal voltage.

- c. Flash protection boundary.
- d. Hazard risk category.
- e. Incident energy.
- f. Working distance.
- g. Engineering report number, revision number, and issue date.

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
 - 1. Engraved legend with black letters on white face or white letters on red face where indicated.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for mounting with mechanical fasteners. Minimum letter height shall be as indicated on the drawings. Label and letter colors shall be as follows:
 - 1. Normal Power:
 - a. Refer to drawings for requirements.
 - 2. Standby Power (NEC 701 and 702):
 - a. Refer to drawings for requirements.
 - 3. Emergency Power (NEC 700):
 - a. Refer to drawings for requirements.
 - 4. UPS Power:
 - a. Refer to drawings for requirements.
 - 5. Fire Alarm Equipment:
 - a. White letters on a red field. Minimum letter height shall be 3/8 inch (10mm)
 - b. Legend: Indicate "Fire Alarm"
 - c. Include a label identifying circuits/circuit breakers feeding fire alarm equipment.
- B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).
- C. Refer to drawings for additional labeling requirements of devices, raceways, junction boxes, equipment, etc.

2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type

6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 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, Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 deg F ((23 deg C)), According to ASTM D 638: 7000 psi (48.2 MPa).
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Nameplates shall be punched or drilled, and secured to equipment using stainless steel mechanical rivets.

2.9 CEILING STICKERS

- A. Manufacturers:
1. Seton Identification Products / Tricor Direct / Brady Corporation.
 2. Brady Worldwide, Inc.
 3. Kolbi Pipe Marker Company.
- B. Description: Stickers to be nylon die-cut and not. Sticker to include black arrow oriented to approximate location of device.
- C. Color code as follows:

1. For disconnect switches located above ceilings: Identify with an Orange ½" round sticker.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels with stainless steel mechanical rivets appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. Raceways and Cables Identification: Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: Owner approval is required before using cable ties for attaching tags. No cable ties will be accepted for exterior labeling attachment. Use general-purpose type, except as listed below:
 1. In Spaces Handling Environmental Air: Plenum rated.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
- K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 20

- A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 25- foot (10-m) maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Emergency Power.
 2. Standby Power.
 3. Normal Power.
 4. UPS Power.
- C. All fire alarm devices, pull boxes, raceways and blank junction box covers shall be painted red. Identify the covers of each fire alarm junction box and pull box with self-adhesive vinyl labels, attached to the side of the box in a visible location, as well as on the cover.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, and handholes, use color-coding conductor tape to identify the phase.
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral: White.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral: Gray.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, vaults, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor and Outdoor Equipment: Engraved, laminated acrylic or melamine label.

- Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - c. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
2. Equipment to be Labeled:
- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Emergency system boxes and enclosures.
 - h. Fire Alarm system boxes and enclosures.
 - i. Enclosed switches.
 - j. Enclosed circuit breakers.
 - k. Enclosed controllers.
 - l. Variable-speed controllers.
 - m. Push-button stations.
 - n. Power transfer equipment.
 - o. Contactors.
 - p. Remote-controlled switches, dimmer modules, and control devices.
 - q. Battery-inverter units.
 - r. Battery racks.
 - s. Power-generating units.
 - t. Monitoring and control equipment.
 - u. UPS equipment.

END OF SECTION 260554

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

- a. Control circuits.
- b. Panelboards.
- c. Switchboards.
- d. Enclosed controllers.
- e. Enclosed switches.

1.3 SUBMITTALS

- A. Action Submittals:

1. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare fuse cabinets. Include the following for each fuse type indicated:

- a. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - 1) For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - 2) Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
- b. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
- c. Current-limitation curves for fuses with current-limiting characteristics.
- d. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in

- electronic format suitable for use in coordination software and in PDF format.
 - e. Coordination charts and tables and related data.
 - f. Fuse sizes for elevator feeders and elevator disconnect switches.
- B. Closeout Submittals:
1. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," include the following:
 - a. Ambient temperature adjustment information.
 - b. Current-limitation curves for fuses with current-limiting characteristics.
 - c. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
 - d. Coordination charts and tables and related data.
- C. Maintenance Material Submittals:
1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.4 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann; a division of Cooper Industries.
 2. Edison; a brand of Cooper Bussmann; a division of Cooper Industries.
 3. Littelfuse, Inc.
 4. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

FUSES

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- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting, time delay.
 - 4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting, time delay.
 - 5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
 - 7. Type T: 600-V, zero- to 800-A rating, 200 kAIC, very fast acting, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance: Class T, fast acting.
 - 2. Feeders: Class L, time delay.
 - 3. Motor Branch Circuits: Class RK1, time delay.
 - 4. Large Motor Branch (601-4000 A): Class L, time delay.

5. Power Electronics Circuits: Class J, high speed.
6. Other Branch Circuits: Class RK1, time delay.
7. Control Transformer Circuits: Class CC, time delay, control transformer duty.
8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260554 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262817 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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:

1. Fusible switches.
2. Non-fusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers, and their entire assembly, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Action Submittals:

1. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and

manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

- a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Current and voltage ratings.
 - c. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - d. Include evidence of NRTL listing for series rating of installed devices, as required.
 - e. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - f. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
2. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - a. Wiring Diagrams: For power, signal, and control wiring, where applicable.

B. Informational Submittals:

1. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
2. Field quality-control reports.
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
3. Manufacturer's field service report.

C. Closeout Submittals:

1. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Refer to Section 260576 "Overcurrent Protection Device Coordination Study" for additional requirements.

1.6 TRADE CONTRACTOR'S QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 4500 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify OAR no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without OAR's written permission.
 4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company.
 - 2. Siemens Power Transmission & Distribution, Inc.
 - 3. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept padlock hasp, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept padlock hasp, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept padlock hasp, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit, included in every disconnect: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit, included in every disconnect which includes a neutral: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Compression type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.
 - 9. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.2 NON-FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company.
 - 2. Siemens Power Transmission & Distribution Inc.
 - 3. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS

- 1, horsepower rated, lockable handle with capability to accept padlock hasp, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept padlock hasp, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept padlock hasp, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit, included in every disconnect: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit, included in every disconnect which includes a neutral: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Compression type, suitable for number, size, and conductor material.
 - 7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.3 RECEPTACLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company.
 - 2. Siemens Power Transmission & Distribution, Inc.
 - 3. Square D; by Schneider Electric.
- B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 600-V ac, Amperage as shown; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept padlock hasp; interlocked with cover in closed position.
- C. Type HD, Heavy-Duty, Single-Throw Non-fusible Switch: 600-V ac, Amperage as shown; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept padlock hasp; interlocked with cover in closed position.
- D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

1. Receptacle Manufacturer and Catalog Number: See Section 262727 "Wiring Devices".

2.4 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Littelfuse, Inc.
2. Mersen USA.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept padlock hasp; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oil-tight key switch for key-to-test function.
2. Oil-tight red ON pilot light.
3. Isolated neutral lug; 100 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company.
2. Siemens Power Transmission & Distribution, Inc.
3. Square D; by Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. Features and Options as called for on drawings:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring system.
 - 6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - 9. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.

10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.6 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. General Electric Company.
 2. Siemens Power Transmission & Distribution, Inc.
 3. Square D; by Schneider Electric.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Options as called for on drawings:
 1. Standard frame sizes and number of poles.
 2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
 7. Alarm Switch: One NC contact that operates only when switch has tripped.
 8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
 9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
 10. Electrical Operator: Provide remote control for on, off, and reset operations.
 11. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.7 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.

3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260549 "Seismic Controls for Electrical Systems."
 1. Do not anchor, attach, or connect framing, supports, connecting rods, support wires, boxes, and similar components and devices on or in fire-rated walls and assemblies. Anchors, bolts, shims, and similar components shall not penetrate or otherwise compromise the integrity of fire-rated walls and assemblies.
 2. Where luminaire fixtures, wiring devices, sensors, raceway, conduit, disconnects, controllers, and similar components and devices are indicated or shown in proximity to fire-rated walls and assemblies, provide metal framing or similar supports to span across and support the fixtures, devices, and components without attachment to or support from the fire-rated walls and assemblies. Refer to Section 26 05 30, "Hangers and Supports for Electrical Systems."
 3. Coordinate electrical work with Division 07, Fireproofing and Firestopping, to identify fire-rated walls and assemblies in the building.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260554 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 TRADE CONTRACTOR'S QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner. Alternatively, infrared windows shall be installed on all equipment, such that when performing infrared scanning work, would otherwise result in a hazard/risk classification higher than 2. Infrared scanning and report issuance shall be completed within 90 days after substantial completion.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 OWNER'S QUALITY ASSURANCE

- A. Owner's independent commissioning and witnessing agency will provide the following

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witnessing and/or review services:

1. Witness electrical tests stated in NETA Acceptance Testing Specification.
2. Witness infrared scan tests.
3. Review and analyze testing reports and confirm compliance.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262817

