

UNT Kerr Hall Dining Renovation

Project Manual - Issue for Construction



Treanor Project #: HE0569.2302.01

Date: January 30, 2025

**Section 00 0107
PROFESSIONAL SEALS**

PROFESSIONAL CERTIFICATIONS – ARCHITECTURAL

The following Drawings and Technical Specifications have been prepared under the direction of the following professionals. The various parts to which their individual responsibilities apply are limited to those identified above their seal:

Drawings: G-series, AD-series, and A-series.

Specification Sections: Divisions 01, 02 ,05 ,06, 07, 08, 09, 10, and 12.



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PROFESSIONAL CERTIFICATIONS – MECHANICAL, ELECTRICAL, PLUMBING

The following Drawings and Technical Specifications have been prepared under the direction of the following professionals. The various parts to which their individual responsibilities apply are limited to those identified above their seal:

Drawings: iM-series, iP-series, and iE-series.

Specification Sections: Divisions 21, 22, 23, 26.



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PROFESSIONAL CERTIFICATIONS – TELECOM, AUDIOVISUAL, SECURITY

The following Drawings and Technical Specifications have been prepared under the direction of the following professionals. The various parts to which their individual responsibilities apply are limited to those identified above their seal:

Drawings: T-series, TA-series, and TY-series.

Specification Sections: Divisions 27, 28.



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END OF SECTION

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**SECTION 01 1000
SUMMARY OF WORK**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes:
 - 1. Project information
 - 2. Work covered by Contract Documents
 - 3. Phased construction
 - 4. Work by Owner
 - 5. Owner-furnished products
 - 6. Access to site
 - 7. Coordination with occupants
 - 8. Work restrictions
 - 9. Specification and drawing conventions
 - 10. Special provisions
 - 11. Purpose of Division 1 – General Requirements

1.03 PROJECT INFORMATION

- A. Owner: University of North Texas System
- B. Project Identification: Kerr Hall Dining Renovation
- C. Project Location: 1413 West Maple St. Denton, TX 76201
 - 1. 1. Owner's Construction Manager
 - 2. 2. Owner's Designated Representative
- D. Architect: Nadia Zhiri

1.04 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
 - 1. 1. Renovation of the existing Kerr residence hall lobby with the addition of a laundry room that extends into what use to be the adjacent dining hall. The renovation will include new restrooms, lounge seating areas, a game room, and a kitchenette.
- B. Type of Contract
 - 1. 1. Project will be constructed under a General Construction Agreement contract.

1.05 PHASED CONSTRUCTION

- A. The Work shall be conducted in one phase.
 - 1. 1. Before commencing Work, submit an updated copy of the Contractor's construction schedule showing the sequence, commencement and completion dates for all phases of the Work.

1.06 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Fees Paid by Owner: Impact Fees.
- C. Fees Reimbursed by Owner: Tap Fees and Meter Fees.

1.07 ACCESS TO SITE

- A. 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. Use of any area outside of work area must be approved by Owner.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather-tight condition throughout construction period. Repair damage caused by construction operations to equal or better condition.

1.08 COORDINATION WITH OCCUPANTS

Full Owner Occupancy: Owner will occupy site and [existing] [adjacent] building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

- a. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
- b. Notify the Owner not less than three (3) days in advance of activities that will affect Owner's operations.

[Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

- B. 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
- C. 2. Provide not less than three (3) day notice to Owner of activities that will affect Owner's operations.]
- D.

1.08 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of a.m. to p.m., Monday through Friday, except as otherwise indicated.
 - 1. 1. Hours for Utility Shutdowns: Coordinated with Owner, with not less than two (2) weeks written notice of intended shutdown.
 - 2. 2. Hours for core drilling and other noisy activities: N/A
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. 1. Notify Owner not less than three (3) days in advance of proposed utility interruptions.
 - 2. 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. 1. Notify Owner not less than three (3) days in advance of proposed disruptive operations.
 - 2. 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Campus: Smoking is not permitted anywhere on any UNT campus.

- F. Employee Identification: Provide identification tags for Contractor personnel working on the Project site. Require personnel to utilize identification tags at all times.

1.09 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. 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. 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 the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
 - 1. 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 - 3. 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.10 SPECIAL PROVISIONS

- A. Review Owner's tree protection and mitigation policy (Denton Campus ONLY) available at
 - 1. <http://policy.unt.edu/policy/8-6>.
 - 2. Review Owner's Campus Design Guidelines (Denton ONLY) available at https://facilities.unt.edu/sites/default/files/DESIGN%20GUIDELINES%202017_rev%203_09.01.17.pdf

1.11 DIVISION 1 – GENERAL REQUIREMENTS

- A. The specification sections contained with Division 01 – General Requirements, serve to expand and define in more detail, the administrative and procedural requirements outlined in Section 007000 – General Conditions. Should any provisions with Division 01 sections be in conflict with the General Conditions, the General Conditions shall govern.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 012100
ALLOWANCES

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 governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to the Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump sum allowances
 - 2. Unit cost allowances
 - 3. Quantity allowances

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Design Professional and Owner of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Design Professional's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Design Professional from the designated supplier.

1.4 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- D. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 LUMP SUM, UNIT COST AND QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Design Professional under allowance and shall include freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Design Professional, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: Should Owner determine that an adjustment is needed in an allowance amount; a Change Order will be prepared based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump sum of \$15,000 for hydroponics system, including required electrical and infrastructure as shown on Drawings.
 - 1. This allowance includes material cost, receiving, handling, and installation, and Contractor overhead and profit .
 - 2. Coordinate quantity allowance adjustment with corresponding unit price requirements of Division 01 Section "Unit Prices."
- B. Allowance No. 2: Lump sum of \$75,000 for exterior and interior branding signage.
 - 1. This allowance includes material cost, receiving, handling, and installation, and Contractor overhead and profit .
 - 2. Coordinate quantity allowance adjustment with corresponding unit price requirements of Division 01 Section "Unit Prices."
 - 3.

END OF SECTION

SECTION 012200
UNIT PRICES

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 unit prices.

1.3 DEFINITIONS

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

1.4 PROCEDURES

- A. Unit prices include all necessary material, cost for delivery, installation, insurance, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 (NOT USED)

END OF SECTION

**SECTION 01 2300
ALTERNATES**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.03 DEFINITIONS

- A. Alternate: An amount proposed by Contractor and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.04 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SCHEDULE OF ALTERNATES

- A. **Alternate #1:** Wood slat ceiling over serving line (CL-4). Base bid ceiling condition over serving line is CL-2M, at the same elevation as the wood slat ceiling, with axiom edge trim panels.
- B. **Alternate #2:** Quarry tile in back-of-house kitchen spaces (TL-9). Base bid condition is seamless epoxy flooring with integral cove base (EP-1).
- C. **Alternate #3:** 1'-6" high glass (GL-1) privacy screens at partial height pony walls throughout the dining hall. Base bid condition is pony wall construction as detailed, with continuous solid surface (SS-1) countertops and no glass privacy screens.
- D. **Alternate #4:** Armstrong Tectum DesignArt Lines Tegular Ceilings (CL-3). Base bid condition is CL-2, finished in custom tile, grid, and trim color to match Color 1 and Color 2.

END OF SECTION

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**SECTION 01 2500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.03 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 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 in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.04 SUBMITTALS

- A. Substitution Requests: Submit one (1) PDF file of each request for consideration. Identify 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 CSI Form 012500.13
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product, fabrication, or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution 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 and 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 substitution 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.

- I. 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. Design Professional's Action: If necessary, Design Professional will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Design Professional will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) days of receipt of request, or seven (7) 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.

1.05 QUALITY ASSURANCE

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

1.06 PROCEDURES

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

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than fifteen (15) days prior to time required for preparation and review of related submittals.
 1. Conditions: Design Professional 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: Not allowed, unless otherwise indicated. If allowed Design Professional will consider requests for substitution if received within sixty (60) days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Design Professional.
 1. Conditions: Design Professional will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Design Professional 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 Design Professional 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 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 012500.13
SUBSTITUTION REQUEST FORM

PROJECT: _____

(After Contract Award)

TO: _____

NO. _____

DATE: _____

Contractor hereby requests acceptance of the following product or system as a substitution in accordance with provisions of Division 01 Section 012500 "Substitution Procedures":

1. SPECIFIED PRODUCT OR SYSTEM

Substitution request for: _____

Specification Section No.: _____ Article/ Paragraph: _____

2. REASON FOR SUBSTITUTION REQUEST

SPECIFIED PRODUCT

PROPOSED PRODUCT

- | | |
|--|---|
| <input type="checkbox"/> Is no longer available | <input type="checkbox"/> Will reduce construction time |
| <input type="checkbox"/> Is unable to meet project schedule | <input type="checkbox"/> Will result in cost savings of |
| <input type="checkbox"/> Is unsuitable for the designated application | \$ _____ to Project |
| <input type="checkbox"/> Cannot interface with adjacent materials | <input type="checkbox"/> Is for supplier's convenience |
| <input type="checkbox"/> Is not compatible with adjacent materials | <input type="checkbox"/> Is for subcontractor's convenience |
| <input type="checkbox"/> Cannot provide the specified warranty | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Cannot be constructed as indicated | _____ |
| <input type="checkbox"/> Cannot be obtained due to one or more of the following: | |
| <input type="checkbox"/> Strike | <input type="checkbox"/> Bankruptcy of manufacturer or supplier |

- Lockout Similar occurrence (explain below)

3. SUPPORTING DATA

- Drawings, specifications, product data, performance data, test data, and any other necessary information to facilitate review of the Substitution Request are attached.
- Sample is attached Sample will be sent if requested

4. QUALITY COMPARISON

Provide all necessary side-by-side comparative data as required to facilitate review of Substitution Request:

	SPECIFIED PRODUCT	PROPOSED PRODUCT
Manufacturer:	_____	_____
Name / Brand:	_____	_____
Catalog No.:	_____	_____
Vendor:	_____	_____
Variations:	_____	_____

(Add Additional Sheets If Necessary)

Local Distributor or Supplier: _____

Maintenance Service Available: Yes No

Spare Parts Source: _____

Warranty: Yes No _____ Years

5. PREVIOUS INSTALLATIONS

Identification of at least three (3) similar projects on which proposed substitution was used:

PROJECT #1

Project: _____

Address: _____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

PROJECT #2

Project: _____

Address: _____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

PROJECT #3

Project: _____

Address: _____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

6. EFFECT OF SUBSTITUTION

Proposed substitution affects other work or trades: No Yes (if yes, explain)

Proposed substitution requires dimensional revisions or redesign of architectural, structural, M-E-P, life safety, or other work:

- No Yes (if yes, attach data explaining revisions)

7. STATEMENT OF CONFORMANCE OF REQUEST TO CONTRACT REQUIREMENTS

Contractor and Subcontractor have investigated the proposed substitution and hereby represent that:

- A. They have personally investigated the proposed substitution and believe that it is equal to or superior in all respects to specified product, except as stated above;
- B. The proposed substitution is in compliance with applicable codes and ordinances;
- C. The proposed substitution will provide same warranty as specified for specified product;
- D. They will coordinate the incorporation of the proposed substitution into the Work, and will include modifications to the Work as required to fully integrate the substitution;
- E. They have included complete cost data and implications of the substitution (attached);
- F. They will pay any redesign fees incurred by the Architect or any of the Design Professional's consultants, and any special inspection costs incurred by the Owner, caused by the use of this product;
- G. They waive all future claims for added cost or time to the Contract related to the substitution, or that become known after substitution is accepted.
- H. The Design Professional's approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Design Professional at the time decision is rendered and Addendum is issued; and that Design Professional's approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed.

Contractor: _____

(Name of Contractor)

Date: _____ By: _____

Subcontractor: _____

(Name of Subcontractor)

Date: _____ By: _____

Note: Unresponsive or incomplete requests will be rejected and returned without review.

8. DESIGN PROFESSIONAL'S REVIEW AND ACTION

- Substitution is accepted.
- Substitution is accepted, with the following comments: _____

- Resubmit Substitution Request:
 - Provide more information in the following areas: _____

 - Provide proposal indicating amount of savings / credit to Owner
 - Bidding Contractor shall sign Bidder's Statement of Conformance
 - Bidding Subcontractor shall sign Bidder's Statement of Conformance
- Substitution is not accepted:
 - Substitution Request received too late.
 - Substitution Request received directly from subcontractor or supplier.
 - Substitution Request not submitted in accordance with requirements.
 - Substitution Request Form is not properly executed.
 - Substitution Request does not indicate what item is being proposed.
 - Insufficient information submitted to facilitate proper evaluation.
 - Proposed product does not appear to comply with specified requirements.
 - Proposed product will require substantial revisions to Contract Documents.

By: _____

Date: _____

Design Professional has relied upon the information provided by the Contractor, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall provide the specified product.

9. OWNER'S REVIEW AND ACTION

Substitution is accepted for items not involving additional costs.

Substitution is not accepted.

By: _____

(Owner's Construction Manager)

Date: _____

END OF FORM

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**SECTION 01 2600
CONTRACT MODIFICATION PROCEDURES**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections:
 - 1. Division 01 Section 016000, "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.03 MINOR CHANGES IN THE WORK

- A. Design Professional will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions." or Architect's Bulletin form.

1.04 CHANGE ORDER REQUESTS

- A. Owner/Design Professional-Initiated Change Order Requests: 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. Change Order Requests issued by Owner/Design Professional are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Change Order Request after receipt of Change Order 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.
 - e. Quotation Form: Use Change Order Request (COR) form. Contractor shall complete the COR Cost Analysis form and the Sub-Contractor shall submit the Sub-Contractor Cost Analysis form with supporting documentation and cost breakdown by line item, or other form approved by Owner.
- B. Contractor-Initiated Change Orders: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Owner/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 Division 01 Section 012500, "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Change Order Request Form: Use Owner's standard Change Order Request form as approved by Owner and Design Professional.

1.05 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: Refer to Division 01, Section 012100, "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit Price Adjustment: Refer to Division 01 Section 012200, "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit price work.

1.06 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Change Order Request, Owner will prepare and issue a Change Order on attached form for signatures of Owner, Design Professional and Contractor.

1.07 CONSTRUCTION CHANGE DIRECTIVE

- A. Work Change Directive: Owner may issue a Construction Change Directive on attached form. 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 Work 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

**SECTION 01 2900
PAYMENT PROCEDURES**

PART 1 – GENERAL

1.01 1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 01 Section 012600 for administrative procedures for handling changes to the Contract.
 - 2. Division 01 Section 013200 for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittal Schedule.
 - 3. Division 00 Section 007000 – University of North Texas System Uniform General Conditions and Supplementary General Conditions 2022, Amended.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Application for Payment. The Schedule of Values is a form provided by Owner to Contractor

1.4 SCHEDULE OF VALUES

- A. A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule
 - 1. 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules including the following:
 - a. Application for Payment form with Continuation Sheets
 - b. Submittal Schedule
 - c. Contractor's Construction Schedule
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven calendar days before the date scheduled for submittal of initial Application for Payment.
 - 3. Sub schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules indicating values correlated with each phase of payment.
- B. Format and Content: Use the 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. 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. a. Project name and location
 - b. b. Name of Architect
 - c. c. Architect's project number
 - d. d. Contractor's name and address
 - e. e. Date of submittal
 - 2. 2. The Schedule of Values is formatted using CSI Divisions. (see form instructions)
 - 3. 3. Draft Submittals: Submit in same format as final payment application
 - 4. 4. Arrange the Schedule of Values in tabular form with separate sections to indicate the following for each item listed:
 - a. a. Related Specification Section or Division
 - b. b. Change Orders (numbers) that affect value
 - c. c. Dollar value

- 1) 1) Percentage of the Contract Sum to nearest one-tenth percent adjusted to total 100 percent.
5. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Owner/Architect will review Contractor's Schedule of Values and approve upon receipt of sufficient detail as deemed satisfactory to Owner/Architect.
6. 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. Include evidence of insurance and storage in bonded warehousing for materials stored off-site.
 - b. For major items provide separate line items for materials and labor based on CSI Master Format Division. Major items include but not limited to:
 - 1) Division 01 - General Requirements
 - 2) Division 02 - Existing Conditions
 - 3) Division 03 - Concrete
 - 4) Division 04 - Masonry
 - 5) Division 05 - Metals
 - 6) Division 06 - Wood, Plastics, Composites
 - 7) Division 07 - Thermal and Moisture Protection
 - 8) Division 08 - Openings
 - 9) Division 09 - Finishes
 - 10) Division 10 - Specialties
 - 11) Division 11 - Equipment
 - 12) Division 12 - Furnishings
 - 13) Division 13 - Special Construction
 - 14) Division 14 - Conveying Equipment
 - 15) Division 21 - Fire Suppression
 - 16) Division 22 - Plumbing
 - 17) Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)
 - 18) Division 25 - Integrated Automation
 - 19) Division 26 - Electrical
 - 20) Division 27 - Communications
 - 21) Division 28 - Electronic Safety and Security
 - 22) Division 31 - Earthwork
 - 23) Division 32 - Exterior Improvements
 - 24) Division 33 - Utilities
 - 25) Division 34 - Transportation
 - 26) Division 35 - Waterway and Marine Construction
 - 27) Division 40 - Process Integration
 - 28) Division 41 - Material Processing and Handling Equipment
 - 29) Division 42 - Process Heating, Cooling, and Drying Equipment
 - 30) Division 43 - Process Gas and Liquid Handling, Purification and Storage Equipment
 - 31) Division 44 - Pollution and Waste Control Equipment
 - 32) Division 45 - Industry-Specific Manufacturing Equipment
 - 33) Division 46 - Water and Wastewater Equipment
 - 34) Division 48 - Electrical Power Generation
7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost.
8. In addition to line item costs of Sections in Division 02 thru 39, furnish line item costs for each item of the following general administrative and procedural cost items.

- a. a. Bonds
- b. b. Insurance
- c. c. Mobilization
- d. d. Field Superintendence
- e. e. Temporary Facilities
- f. f. Trench Safety
- g. g. Clean-up and Disposal
- h. h. Project Close Out
- i. i. Final Cleaning
- j. j. Demobilization
- k. k. Overhead and General Conditions
- l. l. Contractor's Fee
9. 9. Plumbing, HVAC, Electrical and Life Safety work shall be broken down in accordance with the following subcategories as a minimum:
 - a. a. Fire Protection:
 - b. b. Plumbing:
 - c. c. Heating, Ventilating and Air Conditioning (HVAC):
 - d. d. Electrical:
 - e. e. Fire Detection and Alarm:
10. 10. Schedule Updating: Update and resubmit the Schedule of Values before the next Application for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. A. Electronically deliver in a format approved by Owner after the Design Professional has certified the Payment Application Payment processing will start as soon as we receive and date stamp the payment. In return the Contractor will be given a receipt that will be initialed and a photocopy will be provided to the Contractor.
- B. B. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. 1. Initial Application for Payment, Application for Payment at time of Substantial Completion and Final Application for Payment involve additional requirements.
- C. C. Payment Application Times: Progress payment is due once a month.
- D. D. Payment Application Forms: Use Application for Payment form to be furnished by Owner.
- E. E. Application Preparation: Complete every entry on form. Application to be Notarized by a Notary and executed by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. 2. Include amounts of Change Order issued before the last day of construction period covered by application.
 3. 3. Include supporting documentation including subcontractor and supplier invoices.
- F. F. Transmittal: Prepare one copy with original signatures and original notary of each Application for Payment by a method ensuring receipt within 24-hours. The copy shall include waivers of lien, schedule updates, contractor's executive summary and similar attachments.
 1. 1. Transmit each package with a transmittal form listing attachments and recording appropriate information about application including subcontractor supplemental documentation and required general conditions documents.
- G. G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors and suppliers for construction period covered by the previous application.

1. 1. Submit partial lien waivers on each item for amount requested in previous applications after deduction for retainage of each item.
 2. 2. When an application shows completion of an item submit final or full lien waivers.
 3. 3. Owner reserves the right to designate which entities involved in the Work must submit lien waivers.
 4. 4. Submit final Application for Payment with, or proceeded by, final lien waivers from every entity involved with performance of the Work covered by the application that is lawfully entitled to a lien.
 5. 5. Waiver Forms: Submit waivers of lien on forms executed in a manner acceptable to Owner.
- H. H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment.
1. 1. Include the following:
 - a. a. List of subcontractors
 - b. b. Schedule of Values
 - c. c. Contractor's Construction Schedule (preliminary if not final)
 - d. d. Products list
 - e. e. Submittal Schedule (preliminary if not final)
 - f. f. List of Contractor's staff assignments
 - g. g. List of Contractor's principal consultants
 - h. h. Initial progress report
 - i. i. Report of preconstruction conference
 - j. j. Certificates of insurance and insurance policies
 - k. k. Performance and payment bonds
 - l. l. Data needed to acquire Owner's insurance
- I. I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum
 2. 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. J. Final Payment Application: Submit Final Application for Payment within thirty (30) days of Substantial Completion along with releases and supporting documentation not previously submitted and accepted including, but not limited to, the following:
1. 1. Evidence of completion of Project closeout requirements
 2. 2. Insurance certificate for products and completed operations where required and proof taxes, fees and similar obligations were paid
 3. 3. Updated final statement accounting for final changes to the Contract Sum
 4. 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims"
 5. 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens"
 6. 6. AIA Document G707, "Consent of Surety to Final Payment"
 7. 7. Evidence that claims have been settled
- K. K. Electronic Fund Transfer (EFT): Vendors are encouraged to utilize EFT for the distribution of all future payments. To sign up for EFT, complete the a Payment Works profile (Supplier) at, <https://help.paymentworks.com/contactsupport>. Once established, all future payments will be made by EFT. When an EFT payment is made, an email will be sent to the email address you specify on the EFT agreement form. If you have any questions, please contact the Business Service Center at bsc@untsystem.edu or 940-369-5500.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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**SECTION 01 3100
PROJECT MANAGEMENT AND COORDINATION**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General project coordination procedures
 - 2. Administrative and supervisory personnel
 - 3. Coordination drawings
 - 4. Requests for Information (RFIs)
 - 5. Project Web site
 - 6. Project meetings
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

1.03 DEFINITIONS

- A. RFI: Request from Contractor seeking information from each other during construction.

1.04 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule, continually updated, and in a format acceptable to Owner
 - 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. Pre-Installation conferences
 - 7. Project closeout activities
 - 8. Startup and adjustment of systems
 - 9. Project closeout activities

1.05 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown 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 the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. 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.
 - 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 the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Design Professional 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 ceiling plenum to accommodate layout of light fixtures 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, including fire protection requirements.
 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 1¼ -inch 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: Design Professional will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Design Professional determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Design Professional will so inform the Contractor (copy the Owner), who shall make changes as directed and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints in accordance with requirements of Division 01 Section 013300, "Submittal Procedures".
- C. Coordination Digital Data Files: Prepare coordination digital data files in accordance with the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as the original Drawings.
 2. File Preparation Format: DWG, Version, operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
 4. Design Professional will furnish Contractor one set of digital data files of the Drawings for use in preparing coordination digital data files. Refer to Division 01 Section 013300, "Submittal Procedures", for digital data file requirements.
 - a. Design Professional makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings.
 - b. Digital Data Software Program: The Drawings are available in Program.
 - c. Contractor shall execute a data licensing agreement in a form agreeable to the Design Professional.

1.06 CHANGE KEY PERSONNEL

- A. Change Key Personnel Names: Changes to key personnel originally stated in the bid response must include a revised list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.
 2. Key personnel must be same as those proposed in the bid response unless changes are authorized in writing from the Associate Vice Chancellor for System Facilities prior to their first day on the project.

1.07 REQUESTS FOR INFORMATION (RFIS)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI. All RFIs should be sent directly to the Design Professional via email or posted to project collaboration site (if one is being utilized). The Design Professional will redistribute to the appropriate reviewer.
1. Design Professional will return RFIs submitted to Design Professional by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name
 2. Project number
 3. Date
 4. Name of Contractor
 5. Name of Design Professional
 6. RFI number, numbered sequentially
 7. RFI subject
 8. RFI Question
 9. Specification Section number and title and related paragraphs, as appropriate
 10. Drawing number and detail references, as appropriate
 11. Field dimensions and conditions, as appropriate
 12. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 13. Contractor's signature
 14. 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 Design Professional. RFIs should be emailed to Design Professional with the following format standards. 1) RFI should include RFI number in subject line of email along with brief description. 2) Body of email should include question or description of RFI and suggestion. Sketches or other necessary documents should be attached to email in PDF format.
- D. Design Professional's Action: Design Professional will review each RFI, determine action required, and respond. Allow seven (7) business days for Design Professional's response for each RFI. RFIs received by Design Professional after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals
 - b. Requests for approval of substitutions
 - c. Requests for coordination information already indicated in the Contract Documents
 - d. Requests for adjustments in the Contract Time or the Contract Sum
 - e. Requests for interpretation of Design Professional's actions on submittals
 - f. Incomplete RFIs or inaccurately prepared RFIs
 2. Design Professional's action may include a request for additional information, in which case Design Professional's time for response will date from time of receipt of additional information.
 3. Design Professional'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 Division 01 Section 012600, "Contract Modification Procedures".
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Design Professional in writing within ten (10) days of receipt of the RFI response.
- E. On receipt of Design Professional's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Design Professional within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. log with not less than the following:
1. RFI Log Date
 2. Project name

3. Name and address of Contractor
4. Name and address of Design Professional and Construction Manager
5. RFI number including RFIs that were dropped and not submitted
6. RFI description
7. Date the RFI was submitted
8. Request Date
9. Date Design Professional's and Construction Manager's response was received
10. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate
11. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate

1.08 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 Design Professional of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees in advance of meeting.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Design Professional, within three (3) days of the meeting.
- B. Pre-construction Conference: Schedule and conduct a pre-construction conference before starting construction, at a time convenient to Owner and Design Professional, but no later than fifteen (15) days after notice to proceed.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Design Professional, 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.
 3. Agenda: Distribute the agenda to all invited attendees in advance of meeting. Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule
 - b. Phasing
 - c. Critical work sequencing and long-lead items
 - d. Designation of key personnel and their duties
 - e. Lines of communications
 - f. Procedures for processing field decisions and Change Orders
 - g. Procedures for RFIs
 - h. Procedures for testing and inspecting
 - i. Procedures for processing Applications for Payment
 - j. Distribution of the Contract Documents
 - k. Submittal procedures
 - l. Sustainable design requirements
 - m. Preparation of record documents
 - n. Use of the premises and existing building
 - o. Work restrictions
 - p. Working hours
 - q. Owner's occupancy requirements
 - r. Responsibility for temporary facilities and controls
 - s. Procedures for moisture and mold control
 - t. Procedures for disruptions and shutdowns

- u. Construction waste management and recycling
 - v. Parking availability
 - w. Office, work, and storage areas
 - x. Equipment deliveries and priorities
 - y. First aid
 - z. Security
 - aa. Progress cleaning
 - bb. Commissioning requirements/coordination
4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes within three (3) days of meeting date.
- C. Pre-Installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires 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 Design Professional of scheduled meeting dates.
 2. Agenda: Distribute the agenda to all invited attendees in advance of meeting. 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 problems
 - k. Time schedules
 - l. Weather limitations
 - m. Manufacturer's written recommendations
 - 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. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes within three (3) days of meeting date.
 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 Project closeout conference, at a time convenient to Owner and Design Professional, but no later than number 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, Design Professional, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Distribute the agenda to all invited attendees in advance of meeting. 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 sustainable design documentation
 - e. Requirements for preparing operations and maintenance data
 - 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 within three (3) days of meeting date.
- E. Progress Meetings: Conduct progress meetings at agreed upon intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Owner's Commissioning authority, Construction Manager, and Design Professional, each contractor, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Distribute the agenda to all invited attendees in advance of meeting. 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 utilization

- 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
 - 19) Recommendations of construction feasibility
 - 20) Safety precautions and programs
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information within three (3) days of meeting date.
- 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.
- F. Coordination Meetings: Conduct project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.
1. Attendees: In addition to representatives of Owner and Design Professional, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements
 - 2) Sequence of operations
 - 3) Status of submittals
 - 4) Deliveries
 - 5) Off-site fabrication
 - 6) Access
 - 7) Site utilization
 - 8) Temporary facilities and controls
 - 9) Work hours
 - 10) Hazards and risks
 - 11) Progress cleaning
 - 12) Quality and work standards
 - 13) Change Orders

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting, within three (3) days of meeting date.
 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes within three (3) days of meeting date.
- G. Meetings Requested by Owner: While not necessarily coinciding with dates of other meetings, Owner reserves the right to call and conduct meetings with project participants as the need arises.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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**SECTION 01 3200
CONSTRUCTION PROGRESS DOCUMENTATION**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Work Progress Schedule
 - 2. Daily construction reports
 - 3. Material location reports
 - 4. Field condition reports
 - 5. Special reports

1.03 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and/or controlling the construction project. Activities included in a construction schedule that consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
 - a. Baseline Schedule: The initial time schedule prepared by Contractor for Owner's information and acceptance that conveys Contractor's and Subcontractors' activities (including coordination and review activities required in the Contract Documents to be performed by Design Professional and Owner), durations, and sequence of work related to the entire Project to the extent required by the Contract Documents. The schedule clearly demonstrates the Longest Path of activities, durations, and necessary predecessor conditions that drive the end date of the schedule. The Baseline Schedule shall not exceed the time limit current under the Contract Documents.
 - b. Longest Path: The sequence of directly related activities that comprise the longest continuous chain of activities from the start of the first activity to the finish of the last activity. The activities represent critical path plus float plus historical weather days. Each activity in the Longest Path is critical and directly related in that it prevents its successor from being scheduled earlier than it is.
- B. Event: The starting or ending point of an activity.
- C. Work Progress Schedule: The continually updated time schedule prepared and monitored by the Contractor that coordinates and integrates activities of the Project, including Contractor's services, Design Professional's services, the work of other consultants, suppliers, and Owner's activities with the anticipated construction schedules for other contractors. The WPS accurately indicates all necessary and appropriate revisions including a longest path impact analysis, as required by the conditions of the Work and the Project while maintaining a concise comparison to the Baseline Schedule.
- D. Float: The period of time a task can be delayed without delaying Substantial Completion date.

1.04 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.
- B. Contractor's Baseline Schedule: Initial Baseline Schedule due with Guaranteed Maximum Price in a Construction Manager-At-Risk and with the Proposal Response in a CSP, of size

required to display entire schedule for entire construction period. The Baseline Schedule shall become the comparison to the actual conditions throughout the Contract duration and become part of the Contractor's Work Progress Schedule.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (baseline or updated) and date on label.
- C. WPS Reports: Concurrent with WPS schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, and remaining duration in calendar days.
1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity.
 3. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- D. Material Location Reports: Submit at prior to application for payment
- E. Field Condition Reports: Submit at time of discovery of differing conditions
- F. Special Reports: Submit at time of unusual event

1.05 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in WPS scheduling and reporting, with capability of producing WPS reports and diagrams within twenty-four (24) hours of Design Professional's request.

1.06 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. 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.

PART 2 PRODUCTS

2.01 CONTRACTOR'S WORK PROGRESS SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
1. Procurement Activities: Include procurement process activities for long lead items (as identified by Contractor) and major items, requiring a cycle of more than sixty (60) days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 2. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section 013300, "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 3. Startup and Testing Time: Include not less than fifteen (15) days for startup and testing.
 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Design Professional's administrative procedures necessary for certification of Substantial Completion.

5. Punch List and Final Completion: Include not more than thirty (30) days for punch list and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section 011000, "Summary". Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section 011000, "Summary". Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing conditions
 - b. Limitations of continued occupancies
 - c. Uninterruptible services
 - d. Partial occupancy before Substantial Completion
 - e. Use of premises restrictions
 - f. Lead time for future construction
 - g. Seasonal variations
 - h. Environmental control
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards
 - b. Submittals
 - c. Purchases
 - d. Mockups
 - e. Fabrication
 - f. Sample testing
 - g. Deliveries
 - h. Installation
 - i. Tests and inspections
 - j. Adjusting
 - k. Curing
 - l. Startup and placement into final use and operation
 8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion
 - b. Permanent space enclosure
 - c. Completion of mechanical installation
 - d. Completion of electrical installation
 - e. Substantial 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. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
 1. Refer to Division 01 Section 012900, "Payment Procedures" for cost reporting and payment procedures.

- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues
 - 2. Unanswered RFIs
 - 3. Rejected or unreturned submittals
 - 4. Notations on returned submittals
- G. Recovery Schedule: When periodic update indicates the Work is fourteen (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, and equipment required for compliance, and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules. Confirm acceptability of software with Owner. Contractor is responsible for all costs associated with licensing and training of the software.
- I. Schedule shall be updated with the weekly OAC meeting and must include current details for all activities.

2.02 CONTRACTOR'S WORK PROGRESS SCHEDULE (WPS SCHEDULE)

- A. General: Contractor shall submit for review and approval a Baseline Schedule that will indicate starting and completing dates of various aspects required to complete the work using the Longest Path. The Baseline Schedule shall become the comparison to the actual conditions throughout the contract and become a part of the Work Progress Schedule.
- B. Contractor's Work Progress Schedule (WPS) shall coordinate and integrate the services and activities of Contractor, Design Professional and Owner, other consultants/suppliers, subcontractors and requirements of governmental entities. The WPS is due within twenty-one (21) days after the effective date of Notice to Proceed.
- C. Contractor shall be responsible to:
 - 1. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel and Owner's Representative, in proper methods of providing data and using WPS information.
 - 2. Establish procedures for monitoring and updating WPS and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to correlate with Contract Time.
- D. WPS Preparation: Prepare a list of all activities required to complete the Work.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals
 - b. Mobilization and demobilization
 - c. Purchase of materials
 - d. Delivery
 - e. Fabrication
 - f. Utility interruptions
 - g. Installation
 - h. Work by Owner that may affect or be affected by Contractor's activities
 - i. Testing
 - j. Punch list and final completion
 - k. Activities occurring following final completion
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.

3. Processing: Process data to produce output data on a computer drawn, time scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the WPS within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Sub-networks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time impact analysis to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial schedule from a sorted activity list indicating straight "early start ". Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity
 2. Description of activity
 3. Principal events of activity
 4. Immediate preceding and succeeding activities
 5. Activity duration in workdays
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed
 2. Changes in activity durations in workdays
 3. Changes in the critical path
 4. Changes in total float time
 5. Changes in the Contract Time
 6. Show relationship between activities on initial and updated schedule.

2.03 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report record 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. Accidents
 8. Meetings and significant decisions
 9. Unusual events (refer to special reports)
 10. Stoppages, delays, shortages, and losses
 11. Meter readings and similar recordings
 12. Emergency procedures
 13. Orders and requests of authorities having jurisdiction
 14. Change Orders received and implemented
 15. Construction Change Directives received and implemented
 16. Services connected and disconnected
 17. Equipment or system tests and startups
 18. Partial completions and occupancies
 19. Substantial Completions authorized
- B. Material Location Reports: Monthly prepare and submit a comprehensive list of materials delivered to and stored at Project site. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents prepare and submit, to the Design Professional, 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. Executive Summary Reports: Provided monthly with Payment Applications. Provides highlight details, schedule summary, and other information pertinent to Owner, including, but not limited to the following:
 - 1. Table of contents, simple project schedule clearly indicating benchmark dates, a narrative stating the current status of construction, a list of construction concerns, a look at what is coming up, potential change order log, and progress photo's.

2.04 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one (1) day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: 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, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 EXECUTION

3.01 CONTRACTOR'S WORK PROGRESS SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using WPS scheduling.
 - 1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in WPS scheduling and reporting techniques. Submit qualifications.
 - 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's WPS Updating: Update and submit the WPS with the OAC meeting minutes to reflect actual construction progress and activities.
 - 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.
- C. Distribution: Distribute copies of approved schedule to Design Professional, Owner, commissioning agent, 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.

END OF SECTION

**SECTION 01 3233
PHOTOGRAPHIC DOCUMENTATION**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 1. Pre-construction photographs
 2. Periodic construction photographs
 3. Final completion construction photographs
 4. Owner may elect to retain an independent firm to photographically document the progress of the work. Work of this firm shall not diminish or replace responsibilities of the Contractor for documentation required by this section. Contractor to cooperate fully with independent photographer.

1.03 UNIT PRICES

- A. Basis for Bids: Base number of construction photographs on average of twenty (20) photographs per week over the duration of Project.

1.04 INFORMATIONAL SUBMITTALS

- A. Digital Photographs: Submit image files within three days of taking photographs.
 1. Digital Camera: Minimum sensor resolution of 8 megapixels.
 2. Format: Minimum 1600 by 1200 pixels, 400 dpi minimum, in unaltered original files, with same aspect ratio as the sensor, un-cropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project
 - b. Name of Design Professional
 - c. Name of Contractor
 - d. Date photograph was taken
 - e. Description of location, direction (by compass point), and elevation or story of construction

1.05 COORDINATION

- A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities.

1.06 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 PRODUCTS

2.01 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 1600 by 1200 pixels and 400 dpi.

PART 3 EXECUTION

3.01 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image editing software.
 1. Date and Time: Include date and time in file name for each image.
 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- C. Pre-construction Photographs: Before commencement of excavation, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 1. Flag construction limits before taking construction photographs
 2. Take twenty (20) photographs to show existing conditions adjacent to property before starting the Work
 3. Take twenty (20) photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction
 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take twenty (20) photographs monthly (unless otherwise directed), coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Time-lapse Sequence Construction Photographs: Take photographs as indicated, to show status of construction and progress since last photographs were taken.
 1. Frequency: Take photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment.
 2. Vantage Points: Following suggestions by Architect and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time to create a time-lapse sequence as follows:
 - a. Commencement of the Work, through completion of subgrade construction
 - b. Above-grade structural framing
 - c. Exterior building enclosure
 - d. Interior Work, through date of Substantial Completion

END OF SECTION

**SECTION 01 3300
SUBMITTAL PROCEDURES**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.03 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Design Professional'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 Design Professional'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. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. 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.

1.04 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 modifications to submittals noted by the Design Professional 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 start-up construction schedule. Include submittals required during the first sixty (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
 - f. Scheduled date for Design Professional's final release or approval
 - g. Scheduled dates for purchasing
 - h. Scheduled dates for installation
 - i. Activity or event number

1.05 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Design Professional's Digital Data Files: Design Professional will provide electronic copies of CAD Drawings for Contractor's use in preparing coordination submittals.
 - 1. Design Professional will furnish Contractor one (1) set of drawing files for use in preparing Shop Drawings and Project record drawings.
 - 2. Design Professional makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - 3. Digital Drawing Software Program: The Contract Drawings are available in Type software.
 - 4. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
 - 5. CAD files will by furnished for each appropriate discipline.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are approved by Design Professional.
 - 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.
 - 5. Design Professional 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 Design Professional'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. Submittals received after 1:00 pm will be considered to have been received the following day.
 - 1. Allow ten (10) business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Design Professional will advise Contractor when a submittal being processed must be delayed for coordination. Allow fifteen (15) business days for review time for large or complex submittals will require additional review time. The following are examples but not limited to such submittals, Millwork, Curtain Wall, Structural Steel, Doors, Frames, Hardware (total opening).
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow ten (10) business days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Design Professional's consultants, Owner, or other parties is indicated, allow fifteen (15) business days for initial review of each submittal.
- D. Identification and Information: Place a permanent label or title block on each copy submittal item for identification.
 - 1. On large format Shop Drawings, Contractor shall stamp each individual page as well as the reviewer's stamp.
 - 2. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 3. Provide a space approximately 6-inches by 8-inches) on label or beside title block to record Contractor's review and approval markings and action taken by Design Professional.
 - 4. Include the following information for processing and recording action taken:
 - a. Project name
 - b. Date

- c. Name of Design Professional
 - d. Name of Contractor
 - e. Name of subcontractor
 - f. Name of supplier
 - g. Name of manufacturer
 - h. Submittal number or other unique identifier, including revision identifier
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section
 - j. Drawing number and detail references, as appropriate
 - k. Location(s) where product is to be installed, as appropriate
 - l. Other necessary identification
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
- 1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. For typical projects that do not require separate submittals for different buildings or sub the submittal file name shall use Specification Section number followed by a dash and then a sequential number. Resubmittals shall include an numerical suffix after another dash. Include brief description of submittal after sequential number or resubmittal suffix. (e.g., 061000-001-0 Rough Carpentry).
 - b. For complex projects that require project identifier for separate buildings within a project or require individual submittals to be submitted by multiple subcontractors, the submittal file name shall follow the following: Specification Section number followed by a decimal point and then a sequential number. Resubmittals shall include an alphabetic suffix after another decimal point. Project Identifier should follow in parentheses (e.g., 061000-001-0 (LNHS) Rough Carpentry).
 - 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Design Professional.
 - 4. Include the following information on an inserted cover sheet:
 - a. Project name
 - b. Date
 - c. Name and address of Design Professional
 - d. Name of Contractor
 - e. Name of firm or entity that prepared submittal
 - f. Name of subcontractor
 - g. Name of supplier
 - h. Name of manufacturer
 - i. Number and title of appropriate Specification Section
 - j. Drawing number and detail references, as appropriate
 - k. Location(s) where product is to be installed, as appropriate
 - l. Related physical samples submitted directly
 - m. Other necessary identification
 - 5. Include the following information as keywords in the electronic file metadata:
 - a. Project name
 - b. Number and title of appropriate Specification Section
 - c. Manufacturer name
 - d. Product name
- F. Options: Identify options requiring selection by the Design Professional.
- G. Deviations: Identify deviations from the Contract Documents on submittals.

- H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Design Professional observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 - 1. Submit one (1) copy of submittal to concurrent reviewer in addition to specified number of copies to Design Professional.
- I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Design Professional will return submittals, without review, received from sources other than Contractor.
 - 1. Transmittal Form: Use standard contractor form as approved by Design Professional Owner.
 - 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Design Professional on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Include all submitted information from previous submittal in resubmittal, to form a comprehensive document for Design Professional's review.
 - 4. Resubmit submittals until they are marked with 'Reviewed', 'Furnish as Corrected' notation from Design Professional's action stamp, or with approval notation from alternate reviewer
- K. 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.
- L. Use for Construction: Use only final submittals that are marked with 'Reviewed', 'Furnish as Corrected' notation from Design Professional's action stamp, or with approval notation from alternate reviewer.

PART 2 PRODUCTS

2.01 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. Email or upload electronic submittals as PDF electronic files directly to Design Professional's Info Exchange Folder specifically established for Project.
 - a. Design Professional will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Action Submittals: For large format drawings and submittals (larger than 11x17), submit PDF file plus two (2) hard copies. For smaller format drawings and submittals (11x17 or less), provide only PDF file. Design Professional will return only the marked-up PDF.
 - 3. Informational Submittals: Submit two paper copies of each submittal, unless otherwise indicated. Design Professional will not return copies.
 - 4. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section 017700, "Closeout Procedures".
 - 5. 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.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

- b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
 6. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section 014000, "Quality Requirements".
- 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 catalog cuts
 - b. Manufacturer's product specifications
 - c. Standard color charts
 - d. Statement of compliance with specified referenced standards
 - e. Testing by recognized testing agency
 - f. Application of testing agency labels and seals
 - g. Notation of coordination requirements
 - h. Availability and 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. PDF electronic file
- C. Shop Drawings: Prepare Project specific information, drawn accurately to scale.
1. Submittals containing reproduction of Contract Drawings are not considered Shop Drawings and will be returned without action. Any delay due to such rejection will not be grounds for an extension of Contract Time.
 2. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products
 - b. Schedules
 - c. Compliance with specified standards
 - d. Notation of coordination requirements
 - e. Notation of dimensions established by field measurement
 - f. Relationship and attachment to adjoining construction clearly indicated
 - g. Seal and signature of professional engineer if specified
 3. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 4. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8 ½ -inches by 11-inches () but no larger than 30-inches by 42-inches ().
 5. Submit Shop Drawings in the following format:
 - a. For large format drawings and submittals (larger than 11 x 17), submit PDF file plus two (2) hard copies. For smaller format drawings and submittals (11x17 or less), provide only PDF file. Design Professional will return only the marked-up PDF.
- 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
 3. 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.
 4. 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 three (3) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Design Professional will return submittal with options selected.
 5. 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 sets of Samples. Design Professional will retain one sample set; 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. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space
 4. Location within room or space
 5. Submit product schedule in the following format:
 - a. PDF electronic file
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section 013200, "Construction Progress Documentation".
- G. Application for Payment: Comply with requirements specified in Division 01 Section 012900, "Payment Procedures".
- H. Schedule of Values: Comply with requirements specified in Division 01 Section 012900, "Payment Procedures".

- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
 - 4. Submit subcontract list in the following format:
 - a. PDF electronic file
- J. Coordination Drawings: Comply with requirements specified in Division 01 Section 013100, "Project Management and Coordination".
- 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 Design Professionals 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 American Welding Society (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 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. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section 014000, "Quality Requirements".
- U. Pre-construction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit reports indicating and interpreting results of field tests either performed during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. Maintenance Data: Comply with requirements specified in Division 01 Section 017823, "Operation and Maintenance Data".
- Y. 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, 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.

2.02 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 Design Professional.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three (3) 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

3.01 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 Design Professional.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 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.

3.02 DESIGN PROFESSIONAL'S ACTION

- A. General: Design Professional will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Design Professional will review each submittal, make marks to indicate corrections or modifications required, and return it. Design Professional will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. Reviewed
 - 2. Revise and Resubmit
 - 3. Rejected
 - 4. Furnish As Corrected
 - 5. No Action Taken

- C. Informational Submittals: Design Professional will review each submittal and will not return it, or will return it if it does not comply with requirements. Design Professional 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 Design Professional.
- E. Incomplete submittals are not acceptable, will be considered non-responsive, and will be returned without review.
- F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION



SUBCONTRACTORS AND MAJOR MATERIAL SUPPLIERS LIST

Project: _____

To (A/E): _____

From (Contractor): _____
Date: _____
A/E Project Number: _____
Contract For: _____

List Subcontractors and Major Material Suppliers proposed for use on this Project as required by the Construction Documents. Attach supplemental sheets if necessary.

Section Number	Section Title	Firm	Address	Phone Number (Fax Number)	Contact
----------------	---------------	------	---------	---------------------------	---------

Attachments

Signed by: _____ Date: _____

Copies: Owner Consultants _____ _____ _____ _____ _____ _____ File

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**SECTION 01 3516
ALTERATION PROJECT PROCEDURES**

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes:
 - 1. Products and installation for patching and extending Work within construction areas of existing facilities.
 - 2. Providing transition and adjustments
 - 3. Repair of damaged surfaces and finishes
- B. Related Sections include the following:
 - 1. Division 01 Section 015000 "Temporary Facilities and Controls" for construction of temporary fire-rated partitions to separate existing occupied areas from construction areas.

1.03 OCCUPANCY, ACCESS, AND PROTECTION

- A. Entire existing facility or any portion thereof will be occupied during progress of construction for conduct of normal operations. Phase Work in accordance with Section 011000, "Summary".
- B. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage. Perform work not to interfere with operations of occupied areas.
- C. Existing facilities will remain in full operation during execution of this Work. Exercise every precaution to ensure safety and protection for existing facilities, occupants, merchandise, pedestrians, and vehicles. The following must meet required codes and accessibility requirements.
- D. Maintain safe access and egress at all times for occupants, pedestrians, and vehicles.
- E. Provide protection to prevent damage to facilities, merchandise, and vehicles from dust, water, weather, and other similar harmful elements. Refer to Section 015000, "Temporary Facilities and Controls" for additional requirements.
- F. Maintain exiting from facilities to provide safe passage complying with applicable codes.

1.04 SCHEDULING OF WORK

- A. Make arrangements with Owner and schedule Work to avoid interference with normal operations of occupied areas. Submit schedule and summary of applicable Work within occupied areas and obtain Owner approval not less than two (2) days prior to commencement of such Work.
 - 1. Requests for use of certain existing loading docks, passage ways, and other similar spaces within areas outside limits of construction operations will be limited to day-by-day basis and must be approved in advance by Owner.
- B. Coordinate access and scheduling of Work within tenant areas with Owner.

1.05 TORCH-CUTTING AND WELDING PROCEDURES

- A. Notify Owner in advance of torch-cutting and welding operations performed within occupied areas; obtain approval prior to proceeding with such operations.
 - 1. Neither open-flame torch-cutting, welding nor arc-welding are allowed without having secured appropriate permit from Fire Marshal or authority having jurisdiction.
 - 2. Keep portable fire extinguisher of appropriate class within reach during welding or torch-cutting operations.
 - 3. Screen arc-welding from vision of passersby.
 - 4. Maintain a "Fire Watch" for minimum of sixty (60) minutes after completion of each torch-cutting and welding operation.

1.06 UTILITY SERVICE OUTAGES

- A. Keep utility and service outages to minimum and perform only after written approval of Owner is received.
 - 1. Requests for outages will not be considered unless they include an identification of areas which will be affected by proposed outage.
 - 2. Schedule outages for times other than normal business hours.
 - 3. Make requests for outages minimum of five (5) calendar days in advance of proposed outage.
- B. Contractor: Responsible for investigating utility and service lines to determine effect of outage upon building operations outside of limit of operations. Obtain approval in advance from Owner to execute investigations.

KEYS

- A. When necessary to perform Work, Owner will issue keys to existing mechanical/electrical equipment spaces.
- B. Return keys at end of warranty period.

PART 2 - PRODUCTS

3.01 MATERIALS

- A. Type and Quality of Existing Products: Use products or types of construction that exist in structure, as needed to patch, extend, or match existing Work.
 - 1. Generally, Contract Documents do not define products or standards of workmanship present in existing construction.
 - 2. Determine by inspecting and testing products where necessary, referring to existing work as quality standard.
- B. New Materials: Comply with Specifications for each product involved.
 - 1. Match existing products and work for patching existing work.
- C. Materials for Temporary Fire-Rated Partitions: Comply with provisions of Division 01 Section 015000 "Temporary Facilities and Controls".
- D. Salvaged Materials: Salvage sufficient quantities of cut or removed material to replace damaged Work of existing construction, when material is not readily obtainable on current market.
 - 1. Store salvaged items in dry, secure place on site.

PART 3 - EXECUTION

4.01 EXAMINATION

- A. Comply with provisions of Division 01 Section 017300, "Execution".
 - 1. Responsible for verifying existing conditions to determine that all areas meet constructability and are ready for alteration and remodeling.
- B. Discrepancies: Verify dimensions and elevations indicated in layout of existing work.
 - 1. Prior to commencing work, carefully compare and check Contract Documents for discrepancies in locations or elevations of work to be executed.
 - 2. Refer discrepancies among Drawings and existing conditions to Design Professional for adjustment before work affected is performed.

4.02 PREPARATION

- A. Construct temporary fire-rated partitions to separate existing occupied areas from construction and alteration areas. Comply with provisions of Division 01 Section 015000, "Temporary Facilities and Controls".
- B. Cut, move, or remove items as necessary for access to alteration and renovation Work.

1. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, deteriorated masonry and concrete, and other deteriorated materials. Replace materials as specified for finished Work.
 2. Remove debris and abandoned items from area and from concealed spaces.
- C. Cutting and Removal: Perform cutting and removal work to remove minimum necessary, and in manner to avoid damage to adjacent work. Cut finish surfaces such as masonry, tile, plaster, or metals by methods to terminate surfaces in straight line at natural point of division.
- D. Prepare surfaces and remove surface finishes as necessary to provide for proper installation of new materials and finishes.
- E. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.
- F. Provide temporary barriers and closures to control operations to prevent spread of dust to occupied portions of building; refer to Division 01 Section 015000, "Temporary Facilities and Controls".

4.03 INSTALLATION

- A. Coordinate Work of alterations and renovations to expedite completion and to accommodate Owner occupancy.
- B. Remove, cut, and patch Work in manner to minimize damage and to provide means of restoring products and finishes to specified condition.
1. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.
- C. Install products as specified in individual Specification sections.
- D. Where new Work abuts or aligns with existing, perform smooth and even transition to match existing adjacent surface in texture and appearance.
1. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and request instructions from Design Professional as to method of making transition.

4.04 ADJUSTMENTS

- A. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to provide smooth plane without breaks, steps, or soffits.
- B. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.
- C. Fit Work at penetrations of surfaces as specified in Division 01 Section 017300, "Execution".
- D. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections. Repair substrate prior to application of finishes.

4.05 FINISHES

- A. Finish new surfaces as specified in individual Specification sections.
- B. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

4.06 CLEANING

- A. Comply with Division 01 Section 017700, "Closeout Procedures". Thoroughly clean areas and spaces affected by Work. Completely remove paint, mortar, oils, putty and items of similar nature.
- B. Clean Owner occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner occupied areas immediately.

END OF SECTION

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**SECTION 01 4000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.

1.02 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.

1.03 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting 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 control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and control procedures that facilitate compliance with the Contract Document requirements.
 3. Requirements for Contractor to provide quality assurance and control services required by Design Professional, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
1. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.04 DEFINITIONS

- A. 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.
- B. 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. Services do not include contract enforcement activities performed by Design Professional.
- C. Mockups: Full size physical assemblies that are constructed onsite. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
1. Laboratory Mockups: Full-size, physical assemblies constructed at testing facility to verify performance characteristics.
 2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on the project site, consisting of multiple products, assemblies and subassemblies.
 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Pre-construction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or 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 Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- G. Field Quality Control Testing: Tests and inspections that are performed onsite for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. 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, and similar operations.
 - 1. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.
- J. Experienced: When used with an entity or individual, "experienced" 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.

1.05 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Design Professional and Owner for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Design Professional for a decision before proceeding.

1.06 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two (2) dimensions.

1.07 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality Control Plan: For quality assurance and quality control activities and responsibilities.
- B. Contractor's Quality Control Manager Qualifications: For supervisory personnel.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections
 - 3. Description of test and inspection
 - 4. Identification of applicable standards
 - 5. Identification of test and inspection methods
 - 6. Number of tests and inspections required
 - 7. Time schedule or timespan for tests and inspections

8. Requirements for obtaining samples
9. Unique characteristics of each quality control service

1.08 CONTRACTOR'S QUALITY CONTROL PLAN

- A. Quality Control Plan, General: Submit quality control plan within ten (10) days of Notice to Proceed, and not less than five (5) days prior to pre-construction conference. Submit in format acceptable to Design Professional. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality assurance and quality control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality assurance and quality control procedures similar in nature and extent to those required for Project.
 1. Project quality control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: Include in quality control plan a comprehensive schedule of Work requiring testing or inspection, including the following:
 1. Contractor performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor's elected tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections".
 3. Owner performed tests and inspections indicated in the Contract Documents including tests and inspections indicated to be performed by the Commissioning Authority, if applicable.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Design Professional has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.09 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, and telephone number 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 inspecting.
 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 re-inspecting
- 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, and telephone number 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 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, and telephone number 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 whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, 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.

1.10 QUALITY ASSURANCE

- A. General: 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.
- 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, 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 products that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented

according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- 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 installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Pre-construction Testing: Where testing agency is indicated to perform pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality assurance service to Design Professional, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Design Professional.
 2. Notify Design Professional five (5) business days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Design Professional's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven (7) days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed, unless otherwise indicated.
- L. Integrated Exterior Mockups: Construct integrated exterior mockup in accordance with approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual specification sections, along with supporting materials.

- M. Room Mockups: Construct room mockups incorporating required materials and assemblies, finished in accordance with requirements. Provide required lighting and additional lighting where required to enable Design Professional to evaluate quality of the quality of the Work.
- N. Laboratory Mockups: Comply with requirements of pre-construction testing and those specified in individual Specification Sections in Divisions 02 through 49.

1.11 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 inspecting they are engaged to perform.
 - 2. Costs for retesting and re-inspecting 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 required to verify that the Work complies with requirements, whether specified or not.
 - 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. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 3. Notify testing agencies at least 24-hours in advance of time when Work that requires testing or inspecting 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 inspecting 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. 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 Division 01 Section 013000, "Submittal Procedures".
- D. 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 pre-installation 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.
- E. Re-testing/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Design Professional and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Design Professional and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Does not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies 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 inspecting Assist agency in obtaining samples
 4. Facilities for storage and field curing of test samples
 5. Delivery of samples to testing agencies
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency
 7. Security and protection for samples and for testing and inspecting equipment at Project site
- H. Coordination: Coordinate sequence of activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.12 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, 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 Owner, Design Professional 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 Design Professional with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, this 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 re-inspecting corrected work

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TEST AND INSPECTION LOG

- A. 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 Design Professional
 4. Identification of testing agency or special inspector conducting test or inspection
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Design Professional's reference during normal working hours.

3.02 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, 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 Division 01 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

UNT SYSTEM REGULATORY REQUIREMENTS

SECTION 014100

PART 1 GENERAL

1.1 SUMMARY: For all building construction projects on state-owned and state-controlled property (including privately owned buildings built on state-owned and state-controlled property), state agency leased buildings and leased spaces, the adopted editions of the *National Fire Protection Association (NFPA) 101 Life-Safety Code* and *NFPA 1 Fire Code* shall be used as the primary building design codes. Where NFPA 101 or NFPA 1 do not address the specific design/construction under consideration, the adopted edition of the International Code Conference (ICC) code applicable to the design/construction discipline shall be used.

- A. Design and construction codes applicable to UNT System projects, however, the following list is not to be considered all-inclusive:
1. National Fire Protection Association (NFPA) Codes/Standards to use are, but not limited to:
 - a. 2021 edition NFPA 1 Fire Code
 - b. 2019 edition NFPA 13 Standard for the installation of [Fire] Sprinkler Systems
 - c. 2019 edition NFPA 14 Standards for the Installation of Standpipe and Hose Systems
 - d. 2019 edition NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection
 - e. 2019 edition NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances
 - f. 2023 edition NFPA 70 National Electric Code
 - g. 2019 edition NFPA 72 National Fire Alarm Signaling Code
 - h. 2021 edition NFPA 101 Life Safety Code
 2. International Building Code Conference (ICC)
 - a. 2021 edition International Building Code (IBC)¹,
 - b. 2021 edition International Mechanical Code (IMC),
 - c. 2021 edition International Plumbing Code (IPC),
 - d. 2021 edition International Fuel Gas Code (IFGC)
 - e. 2021 edition International Fire Code (IFC),
 3. Local Jurisdiction Codes: *"The State Fire Marshal's Office has directed all state universities and agencies who depend on local fire departments for emergency response and fire suppression to design their construction project with the local fire department in mind. Building and site design shall ensure water supply for fire suppression; fire department access to buildings; locations and compatibility of fire hydrant and fire department connections; fire sprinkler systems; standpipe and hose systems; alarm systems; and other emergency equipment for buildings are constructed for use by the respective local fire department"*².

Local fire code requirements of the respective city where the construction is located (i.e. Denton, Frisco, Dallas and Ft. Worth) pertaining only to the following shall be incorporated into the project's design and construction:

- i) water supply for fire suppression;
- ii) fire hydrant number and locations;
- iii) fire department access to the building;
- iv) KNOX® key access boxes – contact UNT System Fire Marshal for specifics (see below);
- v) fire department connections (FDC & its location);
- vi) fire sprinkler and standpipe systems;
- vii) fire hose connections;

¹ Adopted as State of Texas Building Code

² Memorandum to State Universities "Co-operation with Local Jurisdictions and Fire Departments", G. Mike Davis, State Fire Marshal, July 1, 2001; Chris Connealy, State Fire Marshal, February 4, 2016.

- viii) fire detection & alarm systems;
- ix) elevator emergency operations requirements, and cab sized for stretcher requirements;
- x) bi-directional antenna communication coverage;
- xi) other emergency equipment requirements;
- xii) A *Fire Fighter Air Replenishment System (FARS)* shall be designed and installed in any new building in compliance with the respective city's fire code amendments and per the requirements of the *2021 International Fire Code (IFC), Appendix L, where adopted by the respective city.*

The following links to municipal fire codes are provided only for informational references. Always check for the latest municipal revisions. (municipal list revised 11/2024)

- [Dallas Fire Code Amendments](#)
- [Ft. Worth Fire Code Amendments](#)
- [Denton Fire Code Amendments](#)
- [Frisco Fire Code Amendments](#)

KNOX® key boxes are required to be installed on all state-owned buildings, on buildings located on state-owned or state-controlled property (includes privately owned buildings built on state-owned or state-controlled property) and on buildings leased by or containing leased space by a state agency. For ordering details, contact the UNT System Fire Marshal's Office – pat.dunlap@untsystem.edu or Jackie.miller@untsystem.edu

4.. *Design & Construction Guidelines* –

- a. *The University of North Texas* (access the UNT Facilities Resources webpage at

https://facilities.unt.edu/images/unt_design_and_construction_standards_2024_09.pdf. For design guidelines specific to UNT Discovery Park – access the UNT facilities Resources webpage at [UNT Discovery Park Design Guidelines](#)

- a. Questions regarding the *Design & Construction Guidelines – The University of North Texas* are to be emailed to: Peter.Palacios@unt.edu

3. Elevator and Escalator Construction

- a. *Elevators, Escalators and Related Equipment, Administrative Rules of the Texas Department of Licensing and Regulation, 16 Texas Administrative Code, Chapter 74, §74.100 (Effective February 15, 2016).*
- b. 2021 edition International Building Code (IBC), Chapter 30.

4. Accessibility Standards

- a. *2012 Texas Accessibility Standards (2012 TAS). (Elimination of Architectural Barriers Texas Government Code, Chapter 469. Administered by the Texas Department of Licensing and Regulation. Effective March 15, 2012).*

5. Energy Conservation Design Standards for New Construction and Major Renovation³ Projects:

- Commercial Construction and Major Commercial Renovation⁴: Commercial Provisions of the 2018 International Energy Conservation Code (IECC)⁵
- a. ;

³ Major Renovation Projects: *For the purposes of this subchapter, a major renovation project is a building renovation or improvement where the implementation cost associated with energy or water efficiency improvements is \$2 million or more, based on the initial engineering cost estimate. [34 Tex. Admin. Code §19.33.](#)*

Source Note: *The provisions of this §19.33 adopted to be effective August 13, 2002, 27 TexReg 7174; amended to be effective September 28, 2011, 36 TexReg 6303; amended to be effective April 7, 2016, 41 TexReg 2495.*

⁴Major Renovation Projects: *For the purposes of this subchapter, a major renovation project is a building renovation or improvement where the implementation cost associated with energy or water efficiency improvements is \$2 million or more, based on the initial engineering cost estimate. [34 Tex. Admin. Code §19.33.](#)*

⁵ [34 Tex. Admin Code §19.32](#)

- Low-Rise Residential Building⁶: *Residential Provisions of the 2018 International Energy Conservation Code (IECC)*⁷
- b. ASHRAE 90.1 – 2016 edition.
- 6. Water Conservation Standards
 - “*Water Conservation Design Standards for State Buildings and Institutions of Higher Education Facilities*” prepared by SECO, dated April 2020, as the water conservation design standards for any new construction or major renovation project. Download available at: <https://comptroller.texas.gov/programs/seco/code/>
 - a.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

⁶ Low-Rise Residential Building: Buildings not more than three stories in height above grade that includes sleeping accommodations and a separate means of egress, and where the occupants are primarily permanent in nature (30 or more days in occupancy).

⁷ 34 Tex. Admin Code §19.32

**SECTION 01 4200
REFERENCES**

PART 1 GENERAL

1.01 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.

1.02 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Design Professional's action on Contractor's submittals, applications, and requests, "approved" is limited to Design Professional's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Design Professional. 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": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- 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.

1.03 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.04 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" or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Following are acronyms used by Owner in the Contract Documents:
 - 1. A/E: Architect/Engineer

2. AHJ: Authority Having Jurisdiction
3. BOR: Board of Regents
4. CCD: Construction Change Directive
5. CCL: Construction Cost Limitation
6. CMAR: Construction Manager at Risk
7. CSP: Competitive Sealed Proposal
8. DD: Design Development
9. FPE: Fire Protection Engineer
10. GCs: General Conditions
11. GMP: Guaranteed Maximum Price
12. GSF: Gross Square Feet
13. HSP: HUB Subcontractor Plan
14. HUB: Historically Underutilized Business
15. LA: Landscape Architect
16. LEED: Leadership in Energy and Environmental Design
17. LDs: Liquidated Damages
18. NASF: Net Assignable Square Feet
19. NTP: Notice to Proceed
20. OAC: Owner/Architect/Contractor
21. OCM: Owner's Construction Manager
22. ODR: Owner's Designated Representative
23. PAR: Progress Assessment Report
24. PE: Professional Engineer
25. PM: Project Manager
26. RID: Registered Interior Designer
27. R&R: Repair and Rehabilitation
28. SD: Schematic Design
29. SDs: Schematic Design Drawings
30. UGC/SGC: Uniform General Conditions/Supplemental General Conditions

END OF SECTION

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

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 temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's own forces, Design Professional, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Owner will pay sewer service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Owner will pay water service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Owner will pay electric power service use charges for electricity used by all entities for construction operations.
- E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.
 - 1. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- D. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of the work
 - 2. HVAC system isolation schematic drawing
 - 3. Location of proposed air filtration system discharge
 - 4. Other dust-control measures
 - 5. Waste management plan
 - 6. Comply with other requirements on a per Campus basis

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.

- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

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. 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 $\frac{3}{8}$ -inch OD line posts and 2 $\frac{7}{8}$ -inch OD corner and pull posts, with 1 $\frac{5}{8}$ -inch OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized steel, chain-link fabric fencing; minimum 6-feet high with galvanized steel pipe posts; minimum 2 $\frac{3}{8}$ -inch OD line posts and 2 $\frac{7}{8}$ -inch OD corner and pull posts, with 1 $\frac{5}{8}$ -inch OD top and bottom rails. Provide galvanized steel bases for supporting posts.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mils minimum thickness, with flame-spread rating of 15 or less per ASTM E 84.
- D. Dust Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Design Professional, Construction Manager, and construction personnel office activities and to accommodate project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot square tack and marker boards.
 - 3. Drinking water and private toilet.
 - 4. Coffee machine and supplies.
 - 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 - 6. Lighting fixtures capable of maintaining average illumination of 20 FC at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 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 Division 01 Section 017700 "Closeout Procedures".
- C. Air Filtration Units: HEPA primary and secondary filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

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.
 - 1. Locate facilities to limit site disturbance as specified in Division 01 Section 011000, "Summary."
- 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: Install water service and distribution piping in sizes and pressures adequate for construction.]
- D. [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.]
- E. Sanitary Facilities: Provide temporary toilets, wash 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.
- F. 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.
- G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- H. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- I. [Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.]
- J. [Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead, unless otherwise indicated.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.]
- K. 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.

- L. Telephone:
 - 1. Post a list of important telephone numbers.
 - a. Police and fire departments
 - b. Ambulance service
 - c. Contractor's home office
 - d. Architect's office
 - e. Engineers' offices
 - f. Owner's office
 - g. Principal subcontractors' field and home offices
 - 2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- 3.3 SUPPORT FACILITIES INSTALLATION
- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30-feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 - 2. Maintain support facilities until Design Professional 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 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 sub-base and base for temporary roads and paved areas according to Division 31 Section [Insert Section number], "Earth Moving".
 - 3. Recondition base after temporary use, including removing contaminated material, re-grading, proof rolling, compacting, and testing.
 - 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. 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 nor endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
 - F. 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.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touchup signs so they are legible at all times.
 - G. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section 017419, "Construction Waste Management and Disposal."
 - H. 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.
 - I. Temporary Elevator Use: Refer to Division 14 Sections for temporary use of new elevators.
 - J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
 - K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.
- 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION
- A. 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.
 - 1. Comply with work restrictions specified in Division 01 Section 011000, "Summary."
 - B. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction

- General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Division 31 Section [Insert Section number], "Site Clearing."
- C. 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.
 - D. Tree and Plant Protection: Comply with requirements specified in Division 01 Section 015639, "Temporary Tree and Plant Protection."
 - 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. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
 - F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
 - G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
 - H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
 - I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
 - J. 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 weather-tight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
 - K. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
 - 2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant treated plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48-inches between doors. Maintain water-dampened foot mats in vestibule.
 - 3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 4. Insulate partitions to control noise transmission to occupied areas.
 - 5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 6. Protect air-handling equipment.
 - 7. Provide walk-off mats at each entrance through temporary partition.
 - L. 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.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to 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 CONTROL
- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
 - B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.

2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: 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 permanent HVAC system to control humidity.
 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 forty-eight (48) hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight (48) hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Design Professional.
 - c. Remove materials that can not be completely restored to their manufactured moisture level within forty-eight (48) hours.
- E. Refer to Section 015300, Mold Prevention Measures, for additional requirements.
- 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 twenty-four (24) hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section 017700, "Closeout Procedures."

END OF SECTION

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**SECTION 01 5300
MOLD PREVENTION MEASURES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes: Administrative and procedural requirements to help prevent mold contamination in construction. This section is in addition to requirements contained in Division 01 Section 015000, "Temporary Facilities and Controls".

1.03 SUBMITTALS

- A. Reports: Submit reports required in this Section, including but not limited to the following:
 1. Sightings of existing mold
 2. Window and storefront testing
 3. Moisture contents of materials
 4. Exterior sealant cracks, damage, and deterioration

1.04 QUALITY ASSURANCE

- A. Pre-construction Meeting: Review requirements of this Section at Pre-construction Meeting.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Do not bring finish materials into building until building is in a conditioned state. Protect finish materials stored within building. Stage materials off the floor and cover with waterproof covering. Examples of these materials include, but are not limited to, insulation, gypsum products, wall coverings, carpet, ceiling tile, wood products, etc.
- C. Remove from Project site damaged materials or materials that have become wet. Do not install such materials.

1.06 PROJECT CONDITIONS

- A. Perform daily visual inspections of existing building for existing mold. Report sightings of mold to Architect.
- B. Remove water found within building during construction immediately.
 1. Energize lift stations and sump pumps as early in Project as possible. Use temporary pumps if necessary to get water out of building and drain lines.
- C. Ventilation:
 1. Verify that existing HVAC system is providing positive pressure in building.
 2. Provide adequate air circulation and ventilation during demolition phase(s).
 3. Seal off return air ducts and diffusers to prevent construction dust and moisture from entering occupied areas and HVAC system.
 4. Provide temporary outside air ventilation as building becomes enclosed.
- D. Maintain clean project site, free from hazards, garbage, and debris.
- E. Eating, drinking, and smoking are not permitted within building.
- F. Slope perimeter grades, both temporary and final grades, away from building structure.
- G. Verify that condensate pans drain properly beginning with initial installation.
- H. Flash roof penetrations immediately. Do not allow water to penetrate to floor below.
- I. Seal window openings prior to window installation with plastic to prevent moisture entry.

- J. Sprayed-on Fireproofing: Keep air moving throughout building when using sprayed-on fireproofing.
- K. Cover stored and installed ductwork and installed duct openings with plastic to prevent dust, debris, and moisture from entering ductwork. Repair damaged plastic barrier.
- L. Do not operate air handling equipment below 60° F supply air temperature until building is 100 percent enclosed.
- M. Monitor humidity and temperature for conformance to installation requirements defined by material and equipment manufacturers.
- N. Check moisture content of gypsum board prior to applying finishes. Record findings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 INSTALLATION

- A. Roof Drains: Connect roof drains to risers and storm drainage lines as soon as possible.
- B. Floor Drains: Connect floor drains as soon as possible. Cover floor drains with tape during construction to keep construction debris from blocking drain. Clean out floor drain lines to mains prior to Substantial Completion.
- C. Wall Assemblies:
 - 1. Install exterior wall insulation, vapor retarder, and gypsum board only after building is enclosed.
 - 2. Keep bottom of installed gypsum board off floor ½ -inch.
- D. Cavity Conditions: Clean and inspect cavity conditions prior to covering, sealing, or restricting access. Vacuum-clean cavity spaces prior to covering or enclosing.
- E. Sprayed-On Fireproofing: Remove sprayed-on fireproofing overspray immediately.
- F. Plumbing: Pressure test plumbing piping identified as insulated on Project prior to installation of insulation.
- G. Roof Mounted Equipment: Inspect rooftop units and other roof-mounted equipment for signs of rain leaks immediately after first rain. Water test with hose immediately after installation. Seal leaks immediately.
- H. Windows and Storefront: Water test windows to manufacturer's and Project Manual's specifications. Record findings and forward to Architect.
- I. Sealants: Inspect exterior sealants for cracks, damage, or deterioration. Record findings and forward to Architect.
- J. HVAC Equipment (Permanent HVAC Equipment Used for Temporary Conditioning of Building During Construction Phases): Change filters and clean ductwork interior to remove dirt, dust, debris, and moisture buildup prior to turning Project over to Owner.

3.02 ADJUSTING

- A. Remove damaged materials or materials that have become wet. Replace with new materials.

3.03 DEMONSTRATION

- A. Train and educate Owner's maintenance personnel on use of building systems. Explain how improper operation and shutting down systems during off periods can create mold problems.
- B. Schedule with Owner a review of building for mold problems at 1-year warranty walk-through. Inspect exterior sealants and masonry joints for cracks and other damage or deterioration where water can penetrate building envelope.
- C. Explain to Owner the need for Owner to establish annual building review for mold.

END OF SECTION

**SECTION 01 5720
INDOOR AIR QUALITY PLAN DURING CONSTRUCTION**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Requirements to develop and utilize an indoor air quality plan for the construction operation.
 - 2. A sample plan applicable to all interior construction and trades.
 - 3. Reference:
 - a. "IAQ Guidelines for Occupied Buildings under Construction", 2008 Edition, by the Sheet Metal and Air Conditioning Contractors National Association, Inc.

1.02 TRAINING

- A. Contractor shall provide copies of the plan and training to all subcontractors and appropriate personnel.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXECUTION

- A. Contractor shall utilize a plan to protect the indoor environments from contamination during construction and finish out similar to the following plan.
- B. Contractor shall enforce and verify compliance by all personnel and subcontractors.
- C. Contractor shall take pictures of the related construction operations to verify conformance to each section of the plan. These pictures will be provided to the Architect. A minimum of eighteen (18) pictures (six (6) pictures taken on three (3) separate occasions) will be submitted.

3.02 INDOOR AIR QUALITY PLAN DURING CONSTRUCTION OPERATIONS

- A. Introduction
 - 1. This plan outlines the processes required to assure acceptable air quality. Elements of the program include:
 - a. HVAC Protection and Containing the work area
 - b. Source Control and Modifying HVAC Operation and Reducing Emissions
 - c. Pathway Interruptions
 - d. Intensifying Housekeeping
 - e. Scheduling or Relocation of Occupants

3.03 THESE REQUIREMENTS APPLY TO ALL PARTIES INVOLVED IN DESIGN, CONSTRUCTION, AND BUILDING MOVE IN:

- A. CONTAMINANTS
 - 1. Air contaminants include many different materials. These may include: gases, vapors, chemicals, mold/fungus, pathogens, allergens, particulates and radiation. Eliminating all of these is not possible but reducing the introduction and distribution of these contaminants is possible and desirable. The programs outlined in the following pages are intended to reduce contaminants and provide as clean a building as possible for the residents.
 - 2. The following sections outline procedures and precautions to reduce building contamination and meet the requirements for a healthy environment.
- B. CONSTRUCTION OPERATIONS
 - 1. HVAC PROTECTION: The air conditioning system is the distribution method for air and potential contaminants throughout the building. Keeping the system clean is a necessity.
 - a. All air handling equipment, spiral and fabricated ducts and accessories shall be kept clean during transportation, storage and assembly.
 - b. All lined, spiral and assembled ducts shall be wrapped and protected from dirt and water during transportation and storage.

- c. c. All insulation and lined duct shall be kept dry at all times. Any insulation that has become wet shall be removed and replaced.
 - d. d. Fiberglass duct board in the air handlers and bases shall be kept dry and clean. Exposed fiberglass subject to erosion shall be coated with a sealer to prevent the entry of raw fiberglass into the air stream.
 - 1) 1) Water will not be allowed to stand on any mechanical equipment.
 - e. e. All open ends of installed duct and equipment shall be covered and sealed to prevent the entry of dirt.
 - f. f. All zone boxes shall be wrapped and sealed from dirt and water before installation. Installed zone boxes shall have the openings sealed until permanently connected to the ductwork.
 - g. g. All dampers and attenuators into open chases and ducts shall be covered to reduce dirt entry.
 - h. h. The air handlers shall not be started without MERV 8 filtration in place. Upon system activation, install sheet media on all return openings and filters in zone box plenum openings. These filters must be monitored and changed as necessary to prevent the entry of dirt into the system. The temporary media shall be removed after building flush out and before occupancy.
 - i. i. The return air system should not be used during sheet rock installation, sanding or painting operations.
 - j. j. The building should be kept under a positive pressure as much as possible.
 - k. k. Chase dampers shall be kept closed until the system is activated.
 - l. l. Complete the initial mechanical checklists at system startup.
 - m. m. Replace final filters with new filters before flush out or occupancy per design requirements.
2. SOURCE CONTROL
- a. a. No smoking or tobacco materials shall be allowed on all campuses.
 - b. b. No gasoline or fuel-fired equipment shall be used inside any enclosed building.
 - c. c. Wet processes within the building shall be kept to a minimum.
 - d. d. All chase and wallboard materials shall be protected from water. All damaged materials shall be removed and replaced.
 - e. e. Use low-emission materials and chemicals.
 - f. f. All cleaning involving chemicals shall be performed outside the building wherever possible.
 - g. g. All carpet materials shall be unrolled or unboxed and aired out in a well-ventilated warehouse for a minimum of three days before installation.
 - h. h. All modular furniture shall be aired out in a well-ventilated warehouse for seven days before entry into the building.
 - i. i. Trash shall be cleaned up and removed daily to the appropriate recycle container.
 - j. j. Any mold growth shall be treated according to the procedures shown in the New York City Department of Health "Guidelines on Assessment and Remediation of Fungi in Indoor Environments".
 - k. k. Clean the inside of all walls at the base track to remove excess materials and dirt with a vacuum cleaner before enclosing the wall. This is particularly critical on walls with plumbing or water piping included.
 - l. l. HEPA vacuum all concrete floors before installation of floor covering materials.
 - m. m. No obvious mold or chemical contamination shall be enclosed, hidden or painted.
3. PATHWAY INTERRUPTION
- a. a. Dust-producing operations shall be exhausted to the outside to the extent possible.
 - b. b. Exhaust fans may be installed on each floor to remove dust and contaminants.
 - c. c. The air handler shall supply conditioned air to the floors. Floors with heavy dust or chemical operations shall be exhausted to the outside.
 - d. d. During rain or high-humidity conditions, the air supply coming from the coils shall be cooled to 55° F or the air handler stopped to prevent moist air entry into the

building. Exhaust fans shall not draw moist air into the building. It is preferable to have little airflow to moist air entering the building.

- e. e. Return air dampers and openings shall be covered with filter media during operations that may contaminate the system.
 - f. f. During activities producing airborne particulates in occupied buildings undergoing renovation, or projects whose airspace is connected to occupied buildings, dust producing activities such as, but not limited to, demolition, sanding, buffing, and welding, the Contractor will provide commercial high volume air scrubbers at the rate of 1 per 7000 sq feet (7.53498 sq cm), operate them continuously, and service them per the manufacturer, including high-efficiency particulate arrestance (HEPA) filter replacement.
4. HOUSEKEEPING
- a. a. Food or food residues shall be properly disposed after meals or breaks.
 - b. b. Once the building is enclosed with finishes applied, keep dirt entry to a minimum with walk off mats at all entrances. Clean the mats at least daily.
 - c. c. All sweeping shall be done with dust reducing wax-based sweeping compounds.
 - d. d. All materials shall be kept clean and stored neatly on dunnage or pallets as required by the manufacturer.
 - e. e. Coils, fans, and air handler chambers, including return air chambers, shall be inspected and cleaned if required before start up, final testing and commissioning, and air testing.
 - f. f. All workers shall utilize the proper personal protective equipment per OSHA standards during any operation involving chemicals and dust production.
 - g. g. No food, drink, or smoking shall be allowed within the building after the building is enclosed.
5. SCHEDULING
- a. a. Complete all dust producing and chemical operations before the installation of "sink" materials such as carpet and ceiling tile.
 - b. b. Complete the HVAC control system sufficient to allow the operation of the supply and exhaust systems to control pressurization and contaminants.
 - c. c. Group contaminating operations where possible to maximize exhaust use.

END OF SECTION

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**SECTION 01 6000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 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.

1.02 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.

1.03 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, which is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process 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 specific manufacturer's product is named and accompanied by the words "basis-of-design product", including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.04 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Design Professional's Action: If necessary, Design Professional will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Design Professional will notify Contractor of approval or rejection of proposed comparable product request within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section 013300, "Submittal Procedures".
 - b. Use product specified if Design Professional does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section 013300, "Submittal Procedures". Show compliance with requirements.

1.05 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.

1.06 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 to determine that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements under cover in a weather-tight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.
 - 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.07 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 warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for 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 with the Specifications, prepare a written document using indicated form properly executed.
 - 3. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section 017700, "Closeout Procedures".

PART 2 PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected", Design Professional will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal", or "or approved equal", or "or approved", comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. 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.
 2. 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.
 3. Products:
 - a. Restricted List: 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.
 - b. Non-restricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 - 1) Manufacturers:
 - c. Restricted List: 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.
 - d. Non-restricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 4. 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 indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Design Professional's sample", provide a product that complies with requirements and matches Design Professional's sample. Design Professional'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 Division 01 Section 012500, "Substitution Procedures" for proposal of product.

- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Design Professional from manufacturer's full range" or similar phrase, select a product that complies with requirements. Design Professional will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.02 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Design Professional will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Design Professional may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, it is consistent with the Contract Documents, will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 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 Design Professionals and owners, if requested.
 5. Samples, if requested.

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 7300
EXECUTION**

PART 1 GENERAL

1.01 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.

1.02 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 installed products
 6. Progress cleaning
 7. Starting and adjusting
 8. Protection of installed construction
 9. Correction of the Work

1.03 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Certified Surveys: Submit two (2) paper copies that are certified, sealed and signed by a Texas registered professional land surveyor. Also submit one copy of the survey in CAD format using surface coordinates and one copy of the survey in CAD format using grid coordinates. Coordinate with Owner for the reference coordinate system and CAD guidelines.
- D. Final Property Survey: Submit one (1) digital copy that is certified, sealed and signed by a Texas registered professional land surveyor showing the Work performed. Also submit one copy of the survey in CAD format using surface coordinates and one copy of the survey in CAD format using grid coordinates. Coordinate with Owner for the reference coordinate system and CAD guidelines.

1.05 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, notify Design Professional of locations and details of cutting and await directions from the Design Professional before proceeding. Shore, brace, and support structural element 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 result 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. Mechanical systems piping and ducts
 - f. Control systems
 - g. Communication systems
 - h. Conveying systems
 - i. Electrical wiring systems
 - j. Operating systems of special construction
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, which results in reducing their capacity to perform as intended, or that result 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. Exterior curtain-wall construction
 - d. Equipment supports
 - e. Piping, ductwork, vessels, and equipment
 - f. 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 Design Professional's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain onsite manufacturer's written recommendations and instructions for installation of products and equipment.

1.06 WARRANTY

- A. 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.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, utilize products for patching that comply with requirements of Division 01 Section 018114, "Sustainable Design Requirements".
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Design Professional for the visual and functional performance of in-place materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work. Surveyor will perform a Locative Survey (Category 3) according to the standards set by the Texas Society of Professional Surveyors Manual of Practice.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, 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.
 - 3. Collect and depict all utility infrastructure according to the Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data published by the American Society of Civil Engineers, publication number CI/ASCE 38-02. All utility data must have a quality level clearly associated, either via a geospatial database, CAD layering, plan symbols, and/or plan labels per the guidelines. Design Professional or Engineer will work with Owner to explain and detail costs and benefits so as to achieve the highest quality levels of subsurface utility engineering applicable to the Project and Work.
- 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work
 - b. List of detrimental conditions, including substrates
 - c. List of unacceptable installation tolerances
 - d. Recommended corrections
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Existing Utility Information: Furnish information to Owner 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 caused by differing field conditions outside the control

of the Contractor, submit a request for information to Design Professional according to requirements in Division 01 Section 013100, "Project Management and Coordination".

3.03 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. If discrepancies are discovered, notify Design Professional promptly.
- B. General: Engage a land surveyor to lay out the Work using 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 dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level, and plumb of every major element as the Work progresses.
 - 5. Notify Design Professional when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Design Professional.

3.04 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Owner and Design Professional. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Design Professional before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish, construct and maintain a minimum of two permanent benchmarks on Project site, referenced to Owner's established geographic coordinate system. Benchmarks will function as both horizontal and vertical benchmarks. A registered professional land surveyor must establish the new benchmarks to meet specifications of National Geodetic Survey (NGS) Class RT1 surveys per the latest version of the User Guidelines for Single Base Real Time GNSS Positioning publication. New and re-set benchmarks will comply with the guidelines specified by Appendix B of the Bench Mark Reset Procedures document published by the NGS agency.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. D. Mapping As-built Conditions: Once inspected and approved by Owner, all underground utility locations will be mapped using GPS mapping equipment to decimeter precision or better, prior to backfill, to collect geospatial data on as-built conditions. Any work covered prior to mapping will be required to be uncovered at no cost or schedule impact to the project. Consult with Owner for guidelines on how to collect the geospatial data and what information needs to be recorded about each utility feature. This information will be incorporated into the project record drawings to indicate the horizontal and vertical location of facilities, easements and improvements, as built.

3.05 INSTALLATION

- A. General: 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.
- 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 the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory-prepared and field-installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. 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.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Design Professional.
 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.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.06 CUTTING AND PATCHING

- A. Cutting and Patching, 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. Temporary Support: Provide temporary support of work to be cut.
- C. 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.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section 011000, "Summary".
- E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned; bypass such services/systems before cutting to prevent interruption to occupied areas.
- F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 - 4. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather-tight condition.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.07 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Pre-installation Conferences: Include Owner's construction personnel at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.08 PROGRESS CLEANING

- A. General: 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 (7) days during normal weather or three (3) days if the temperature is expected to rise above 80° F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Utilize containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.
- 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 in Finished Areas: 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 Division 01 Section 015000, "Temporary Facilities and Controls" and Division 01 Section 017419, "Construction Waste Management and Disposal".
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

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

3.09 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 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 Division 01 Section 014000, "Quality Requirements".

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

**SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging non-hazardous demolition and construction waste
 - 2. Recycling non-hazardous demolition and construction waste
 - 3. Disposing of non-hazardous demolition and construction waste

1.03 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.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.04 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling a minimum of seventy-five percent (75%) by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
 - 1. Demolition Waste:
 - a. Concrete
 - b. Concrete reinforcing steel
 - c. Brick
 - d. Concrete masonry units
 - e. Doors and frames
 - f. Door hardware
 - g. Metal studs
 - h. Gypsum board
 - i. Acoustical tile and panels
 - j. Carpet
 - k. Carpet pad
 - l. Plumbing fixtures
 - m. Piping
 - n. Mechanical equipment
 - o. Refrigerants
 - p. Electrical conduit
 - q. Copper wiring

- r. Lighting fixtures
- s. Switchgear and panelboards
- t. Transformers
- 2. Construction Waste:
 - a. Site-clearing waste
 - b. Masonry and CMU
 - c. Lumber
 - d. Wood sheet materials
 - e. Wood trim
 - f. Metals
 - g. Carpet and pad
 - h. Gypsum board
 - i. Piping
 - j. Electrical conduit
 - 1) Packaging: Regardless of salvage/recycle goal indicated in paragraph above, salvage or recycle one-hundred percent (100%) of the following uncontaminated packaging materials:
 - (a) Paper
 - (b) Cardboard
 - (c) Boxes
 - (d) Plastic sheet and film
 - (e) Polystyrene packaging
 - (f) Wood crates
 - (g) Plastic pails

1.05 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within thirty (30) days of date established for commencement of the Work.

1.06 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with LEED Submittal. Include the following information:
 - 1. Material category
 - 2. Generation point of waste
 - 3. Total quantity of waste in tons (tonnes)
 - 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes)
 - 5. Quantity of waste recycled, both estimated and actual in tons (tonnes)
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes)
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- E. LEED Submittal: LEED letter template for Credit MRc5, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.
- F. Qualification Data: For waste management coordinator refrigerant recovery technician.

- G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.07 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of Projects with similar requirements.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section 013100, "Project Management and Coordination". Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.08 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site clearing, and construction waste generated by the Work. Use attached form or comparable generated by Contractor. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 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 Division 01 Section 015000, "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- 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 occurring at Project site.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Division 01 Section 015000, "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.02 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: NOT Permitted on Project site.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Plumbing Fixtures: Separate by type and size.
- F. Lighting Fixtures: Separate lamps by type and protect from breakage.

3.03 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.

- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.04 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: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

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**SECTION 01 7700
CLOSEOUT PROCEDURES**

PART 1 GENERAL

1.01 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.

1.02 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

1.03 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Advise Owner of pending insurance changeover requirements.
 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 6. Deliver attic stock and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. 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. Re-inspection: Request re-inspection 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.

1.04 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Division 01 Section 012900, "Payment Procedures".
 - 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Submit pest-control final inspection report and warranty.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. 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. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected. Include cost for re-inspection based on incomplete work of the Contractor.

1.05 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A attached or form provide by Contractor and approved by Owner and Architect.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name
 - b. Date
 - c. Name of Architect
 - d. Name of Contractor
 - e. Page number
 - 4. Submit list of incomplete items in the following format:
 - a. PDF electronic file
 - b. Three (3) paper copies of product schedule or list, unless otherwise indicated. Architect will return two (2) copies.

1.06 WARRANTIES

- A. Submittal Time: Submit written warranties for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within fifteen (15) days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 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 8½ by 11-inch (215-by-280-mm) 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.
 4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals. Included digital copies of each warranty within appropriate division of operations and maintenance manuals.
- E. After final assembly, scan entire warranty binder into PDF format and deliver to Owner. Deliver entire closeout package to owner in PDF format on a thumb drive.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 EXECUTION

3.01 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 portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor 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. Sweep concrete floors clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.

- l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard ACR-2013.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section 017419, "Construction Waste Management and Disposal".

END OF SECTION

**SECTION 01 7823
OPERATION AND MAINTENANCE DATA**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory
 - 2. Emergency manuals
 - 3. Operation manuals for systems, subsystems, and equipment
 - 4. Product maintenance manuals
 - 5. Systems and equipment maintenance manuals

1.03 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.

1.04 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Design Professional.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. One (1) paper copy. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Design Professional will return.
- C. Initial Manual Submittal: Submit draft copy of each manual to Owner and Design Professional at least thirty (30) days before commencing demonstration and training. Design Professional, Owner, and Commissioning Agent 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 fifteen (15) days before commencing demonstration and training. Design Professional and Commissioning Agent will return copy with comments.
 - 1. Correct or modify each manual to comply with Design Professional's and Commissioning Agent's comments. Submit copies of each corrected manual within fifteen (15) days of receipt of Design Professional's and Commissioning Agent's comments and prior to commencing demonstration and training.

PART 2 PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
 - 1. List of documents
 - 2. List of systems
 - 3. List of equipment

4. Table of contents
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of a system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- 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 4-2008, "Preparation of Operating and Maintenance Documentation for Building Systems".

2.02 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: 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 Construction Manager
 7. Name and contact information for Design Professional
 8. Name and contact information for Commissioning Agent
 9. Names and contact information for major consultants to the Design Professional that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. 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: Enable bookmarking of individual documents based upon 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 upon opening file.

- F. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound, and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf or post-type binders, in thickness necessary to accommodate contents, sized to hold 8½ by 11-inch (215-by-280-mm) 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 (2) or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL", Project title or name and subject matter of contents. Indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8½ 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.

2.03 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency
 2. Emergency instructions
 3. Emergency procedures
- B. 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
- C. 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.
- D. 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

2.04 OPERATION MANUALS

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

2.05 PRODUCT MAINTENANCE MANUALS

- A. 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.
- B. 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.
- C. 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
- D. 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
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. 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

2.06 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. 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 warranty and bond information, as described below.
- B. 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.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins
 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
- D. 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
- E. 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.
- F. 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.

- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 EXECUTION

3.01 MANUAL PREPARATION AND DELIVERY

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. 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.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 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.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.
 - 1. 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.
- F. 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 operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Division 01 Section 017839, "Project Record Documents".
- G. Comply with Division 01 Section 017700, "Closeout Procedures" for schedule for submitting operation and maintenance documentation.
- H. Include transmittal with all deliveries to Owner. Request receipt confirmation.

END OF SECTION

**SECTION 01 7839
PROJECT RECORD DOCUMENTS**

PART 1 GENERAL

1.01 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.

1.02 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

1.03 DEFINITIONS

- A. Geospatial Data: Data or information that identifies the geographic location of features and boundaries in relation to the Owner's coordinate system.

1.04 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal: Submit one (1) paper copy and PDF electronic files of marked-up record prints and one (1) set of plots from corrected record digital data files. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal: Submit one (1) paper copy, PDF electronic files, CADD and BIM of marked-up record prints, one (1) set of record digital data files, and three (3) sets of record digital data file plots. Plot each drawing file, whether or not changes and additional information were recorded.
 - c. Architect will amend record CADD files for submission to Owner at completion of project.
- B. Record Specifications: Submit one (1) paper copy and one (1) PDF copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one (1) paper copy, one (1) PDF copy of each submittal, and one (1) CoBIE format.
 - 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: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one (1) paper copy of each submittal.
- E. Reports: Submit written report indicating items incorporated in Project record documents concurrent with progress of the Work, including modifications, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 PRODUCTS

2.01 RECORD DRAWINGS

- A. Record Prints: Maintain one (1) set of marked-up paper copies of the Contract Drawings and Shop Drawings.
 - 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 archive 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 below first floor
 - 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. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets 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: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Format: As approved by Owner.
 3. Format: Annotated PDF electronic file with comment function enabled.
 4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 5. Refer instances of uncertainty to Architect through Construction Manager for resolution.
 6. Incorporate geospatial data collected during construction and installation to more accurately reflect as-built conditions.
- C. Newly-Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
 1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 2. Consult Architect and Construction Manager for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
 - a. Project name
 - b. Date
 - c. Designation "PROJECT RECORD DRAWINGS"
 - d. Name of Architect and Construction Manager
 - e. Name of Contractor

2.02 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 a scanned PDF electronic file of the marked up paper copy of Specifications.

2.03 RECORD PRODUCT DATA

- A. 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.
- B. Format: Submit record Specifications as a scanned PDF electronic file and CoBIE format of the marked up paper copy of Specifications.
 1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

2.04 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 record Specifications as a scanned PDF electronic file of the marked up paper copy of Specifications.
 1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 EXECUTION

3.01 RECORDING AND MAINTENANCE

- A. Recording: Maintain one (1) copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples 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 and Construction Manager's reference during normal working hours.

END OF SECTION

**SECTION 01 7900
DEMONSTRATION AND TRAINING**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment
 - 2. Training in operation and maintenance of systems, subsystems, and equipment
- B. Related Sections:
 - 1. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections

1.03 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.04 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section 014000, "Quality Requirements", experienced in operation and maintenance procedures and training.
- C. Pre-Instruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section 013100, "Project Management and Coordination". Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.05 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Design Professional.

PART 2 PRODUCTS

2.01 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions
 - b. Performance and design criteria if Contractor is delegated design responsibility
 - c. Operating standards
 - d. Regulatory requirements
 - e. Equipment function
 - f. Operating characteristics
 - g. Limiting conditions
 - h. Performance curves
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals
 - b. Operations manuals
 - c. Maintenance manuals
 - d. Project record documents
 - e. Identification systems
 - f. Warranties and bonds
 - g. Maintenance service agreements and similar continuing commitments
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages
 - b. Instructions on stopping
 - c. Shutdown instructions for each type of emergency
 - d. Operating instructions for conditions outside of normal operating limits
 - e. Sequences for electric or electronic systems
 - f. Special operating instructions and procedures
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures
 - b. Equipment or system break-in procedures
 - c. Routine and normal operating instructions
 - d. Regulation and control procedures
 - e. Control sequences
 - f. Safety procedures
 - g. Instructions on stopping
 - h. Normal shutdown instructions
 - i. Operating procedures for emergencies
 - j. Operating procedures for system, subsystem, or equipment failure
 - k. Seasonal and weekend operating instructions
 - l. Required sequences for electric or electronic systems
 - m. Special operating instructions and procedures

5. Adjustments: Include the following:
 - a. Alignments
 - b. Checking adjustments
 - c. Noise and vibration adjustments
 - d. Economy and efficiency adjustments
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions
 - b. Test and inspection procedures
7. Maintenance: Include the following:
 - a. Inspection procedures
 - b. Types of cleaning agents to be used and methods of cleaning
 - c. List of cleaning agents and methods of cleaning detrimental to product
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance
 - f. Procedures for routine maintenance
 - g. Instruction on use of special tools
8. Repairs: Include the following:
 - a. Diagnosis instructions
 - b. Repair instructions
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions
 - d. Instructions for identifying parts and components
 - e. Review of spare parts needed for operation and maintenance

PART 3 EXECUTION

3.01 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training modules. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section 017823, "Operations and Maintenance Data".
- B. Set up instructional equipment at instruction location.

3.02 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.03 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified individual to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 1. At beginning of each training module, record each chart containing learning objective and lesson outline.

- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
 - a. Name of Contractor/Installer
 - b. Business address
 - c. Business phone number
 - d. Point of contact
 - e. E-mail address
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed fifteen (15) minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds fifteen (15) minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Pre-produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION

**SECTION 01 9113
GENERAL COMMISSIONING REQUIREMENTS**

PART 1 GENERAL

2.01 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.
- B. OPR and BoD documentation are included by reference for information only.

2.02 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

2.03 DEFINITIONS

- A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

2.04 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 - 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 - 2. Representatives of the facility user and operation and maintenance personnel.
 - 3. Architect and engineering design professionals.

2.05 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the Design Professional, CxA and Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Design Professional and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

2.06 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 - 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 - 3. Attend commissioning team meetings held on a monthly basis.
 - 4. Integrate and coordinate commissioning process activities with construction schedule.
 - 5. Review and accept construction checklists provided by the CxA.
 - 6. Complete electronic construction checklists as Work is completed and provide to the CxA.
 - 7. Review and accept commissioning process test procedures provided by the CxA.
 - 8. Complete commissioning process test procedures.

2.07 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team
- B. Provide commissioning plan
- C. Convene commissioning team meetings
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
- F. Prepare and maintain the Issues Log
- G. Prepare and maintain completed construction checklist log
- H. Witness systems, assemblies, equipment, and component startup
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 02 4119
SELECTIVE DEMOLITION**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Salvage of existing items to be reused or recycled.

1.02 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, 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.

1.03 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

1.04 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 environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of selective demolition activities with starting and ending dates for each activity.
- D. Predemolition photographs or video.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.05 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

1.06 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.07 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. 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. Hazardous materials will be removed by Owner before start of the Work.
 - 2. 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.

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

1.08 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

PART 2 PRODUCTS

2.01 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

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- C. Inventory and record the condition of items to be removed and salvaged.

3.02 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.03 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 indicated services/systems when requested by Contractor.
 2. Arrange to shut off utilities with utility companies.
 3. 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.
 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.04 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.
- 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.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.05 SELECTIVE DEMOLITION

- 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. 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.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. 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.
 - 4. Maintain fire watch during and for at least ???Insert number??? hours after flame-cutting operations.
 - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 6. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.06 CLEANING

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or 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. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

**SECTION 05 7000
DECORATIVE METAL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative metal panels as shown on drawings and schedules.
- B. Drawings and general provisions of the Contract Documents apply to work of this section.

1.02 REFERENCE STANDARDS

- A. ICC-ES ESR-4405 - Evaluation Report for Shoe Glass Panel Railing System; 2022, with Editorial Revision.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- C. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2" per 12" inches.
- D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
 - 1. Include samples of trim and accessories involving color selection.
- E. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
 - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.
- F. Executed warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall have a minimum of 5 years experience in manufacturing decorative metal panels for commercial use.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the project site in manufacturer's original packaging, properly labeled for identification and installation purposes.
- B. Store in location to avoid damage from job-site traffic, direct sunlight, moisture, stacking or other job-site contaminants. Store in a completely supported flat position. Edge storage is not recommended.
- C. Handle components to avoid denting or scratching of finished surfaces.
- D. DO NOT use markers on protective PVC film. Some types of ink will permeate the film and mark the material surface.

1.06 FIELD CONDITIONS

- A. Maintain a constant temperature range of 65°F to 85°F (18°C to 24°C), with stable relative humidity, for at least 48 hours prior to, throughout the installation period and maintained consistently thereafter.
- B. Installation locations must be enclosed, weatherproofed and climate controlled prior to commencing installation.
- C. Do not install if relative humidity is greater than 80%.

1.07 WARRANTY

- A. Manufacturer Warranty: Provide Manufacturer's warranty against defects in material and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Móz Designs, Inc. or comparable product by one of the following:
 1. ATAS
 2. Englert
 3. Pac-Clad

2.02 METALS

- A. Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for complete installation.
 1. Corrugated-Profile, Exposed-Fastener Metal Wall Panels: Formed with alternating curved ribs spaced at 2.67 inches (68 mm) o.c. across width of panel.
 - a. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - 1) Thickness: 0.040 inch (1.02 mm).
 - 2) Surface: Smooth, flat finish.
 - 3) Exterior Finish: Manufacturer's proprietary powder coat finish
 - 4) Color: Match Architect's samples.

2.03 MISCELLANEOUS METALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275) hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closures: Provide closures at corners, trim, and top-of-wall copings, fabricated of same metal as metal panels.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine product, substrates and installation conditions.
- B. Notify the Contractor and Architect in writing of any conditions detrimental to the proper and timely completion of the installation.
- C. Do not proceed with work until conditions have been corrected.
- D. Do not proceed with work until detrimental conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Protect existing work.
- B. Prior to installation, clean surface to remove dirt, debris and loose particles. Perform additional preparation procedures as required per the manufacturer's instructions.
- C. Protection: Take all necessary precautions to prevent damage to materials during installation.

3.03 INSTALLATION

- A. Install the work of this section in strict accordance with Manufacture's written Technical Information and workability guidelines

3.04 CLEANING

- A. Remove protective film from exposed metal surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

3.05 PROTECTION

- A. Protect installed components and finishes from damage after installation.
- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
- C. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

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**SECTION 06 1053
MISCELLANEOUS ROUGH CARPENTRY**

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. Wood and plywood blocking and nailers.
 - 2. Plywood backing panels.

1.03 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches (50.8 mm) nominal or greater but less than 5 inches (127 mm) nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NHLA: National Hardwood Lumber Association.
 - 3. NLGA: National Lumber Grades Authority.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.04 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. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.05 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.

1.06 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed

sizes for dry lumber.

- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or 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.
- D. Application: Treat
 - 1. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
 - 2. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine, No. 2 grade; SPIB.
 - 2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 - 3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. 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.

2.04 PLYWOOD FOR BLOCKING AND NAILERS

- A. Plywood: DOC PS 1, Exterior, AC, in thickness indicated.
- B. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- C. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- D. Application: Treat all plywood used for blocking and nailers.

2.05 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.06 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406.4 mm) o.c.
- F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.02 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 miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

**SECTION 06 4116
PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Plastic-laminate-clad architectural cabinets.
 - 2. Cabinet hardware and accessories.
 - 3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
- C. Samples: For each exposed product and for each color and texture specified.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.05 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

PART 2 PRODUCTS

2.01 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.
- F. Exposed Surfaces:
 - 1. Plastic-Laminate Grade: HGS.
 - 2. Edges: Grade HGS.
 - 3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
- H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by laminate manufacturer's designations.

2. Match Architect's sample.
3. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Wood grains, matte finish.

2.02 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 2. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper.

2.03 CABINET HARDWARE AND ACCESSORIES

- A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- C. Pulls: Metal, Basis of Design: Doug Mockett DP305 Series Blade Drawer Pull, color matte black.
- D. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
- E. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
- F. Door Locks: ANSI/BHMA A156.11, E07121.
- G. Drawer Locks: ANSI/BHMA A156.11, E07041.
- H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- I. Grommets for Cable Passage: 2-inch (32-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 1. Color: Black.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Architect's sample.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.04 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.
 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.05 FABRICATION

- A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch (3.18 mm) in 96 inches (2438.4 mm) using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (406.4 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

END OF SECTION

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**SECTION 06 4216
FLUSH WOOD PANELING**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Flush wood paneling (wood-veneer wall surfacing).
 - 2. Fire-retardant-treated materials.
 - 3. Installation materials.
- B. Related Requirements:
 - 1. Section 057000 "Decorative Metal" for metal reveals at wood paneling.
 - 2. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling that is concealed within other construction before paneling installation.

1.02 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: For flush wood paneling.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Show details full size.
 - 3. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
 - 4. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
 - 5. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
 - 6. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.
- D. Samples for Initial Selection: For each type of exposed finish.
- E. Samples for Verification: For the following:
 - 1. Lumber for Transparent Finish: Not less than 5 inches (127 mm) wide by 12 inches (304.8 mm) long, for each species and cut, finished on one side and one edge.
 - 2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished paneling.
 - 3. Veneer-Faced Panel Products for Transparent Finish: 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product.
- C. Quality Standard Compliance Certificates: AWI Quality Certification Program
- D. Retain "Evaluation Reports" Paragraph below for fire-retardant-treated materials.
- E. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Shop Certification: AWI's Quality Certification Program accredited participant
- C. Retain "Installer Qualifications" Paragraph below if required. If AWI Quality Certification Program labels or certificates are required for installation, Installer must be a certified participant. If paneling must be FSC certified, fabricator must install paneling or be FSC certified for chain of custody.
- D. Installer Qualifications: Fabricator of products: AWI's Quality Certification Program accredited participant

1.06 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of typical paneling as shown on Drawings ???Insert description???
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.08 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Environmental Limitations with Humidity Control: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 ???Insert numbers??? percent during the remainder of the construction period.
- C. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.
- D. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 PRODUCTS

2.01 SOURCE LIMITATIONS

- A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling wood-veneer-faced architectural cabinets.

2.02 PANELING FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by the following:

2.03 PANELING, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.
 - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced woodwork quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

2.04 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

- A. Grade: Premium
- B. Wood Species and Cut: Poplar, Flat cut
- C. See AWS for explanation and diagrams of different types of matching.
- D. Veneer Matching Method:
 - 1. Adjacent Veneer Leaves: Book match.
 - 2. Within Panel Face: Running match.
 - 3. Adjacent Veneer Leaves and within Panel Face: Slip, center-balance, or book match.
- E. Panel-Matching Method:
 - 1. No matching is required between adjacent panels. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
 - 2. Premanufactured panel sets used full width within each separate area.
 - a. See Section 011000 "Summary" for requirements concerning flitches reserved by Architect.
- F. Vertical Panel-Matching Method: Continuous end match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.
- G. Panel Core Construction: Hardwood veneer-core plywood.
 - 1. Thickness: 3/4 inch (19.05 mm).
- H. Exposed Panel Edges: Inset solid-wood or wood-veneer matching faces
- I. Fire-Retardant-Treated Paneling: Panels are to consist of wood-veneer and fire-retardant particleboard or fire-retardant, medium-density fiberboard (MDF). Panels are to have a flame-spread index of 25 or less and a smoke-developed index of 450 or less per ASTM E84, and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
- J. Assemble panels by gluing and concealed fastening.

2.05 MATERIALS

- A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
- B. Wood Moisture Content: 5 to 10 percent.
- C. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
 - 1. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.06 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (320.04 cm) beyond the centerline of the burners at any time during the test.
1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of paneling.
- C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E84.
1. For panels 3/4 inch (19.05 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi (11031.62 kPa); modulus of elasticity, 300,000 psi (2068428.00 kPa); internal bond, 80 psi (551.58 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.
 2. For panels 13/16 to 1-1/4 inches (32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi (8963.19 kPa); modulus of elasticity, 250,000 psi (1723690.00 kPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.
- D. Fire-Retardant Fiberboard: MDF panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E84.

2.07 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.
- C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

2.08 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.

1. Lay out one elevation at a time if approved by Architect.
 2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
 3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
 4. Rearrange paneling as directed by Architect until layout is approved.
 5. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.
- C. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Notify Architect seven days in advance of the dates and times paneling fabrication will be complete.
- D. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.09 SHOP FINISHING

- A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Shop Priming: Shop apply the prime coat including backpriming, if any, for paneling specified to be field finished.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.
1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.
- D. Transparent Finish:
1. Grade: Premium.
 2. Finish: System - 1, nitrocellulose lacquer.
 3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 4. Staining: Match Architect's sample.
 5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
 7. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.
- E. Opaque Finish:
1. Grade: Premium.
 2. Finish: Scuffmaster Tough Max, Custom Color
 3. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 EXECUTION

3.01 PREPARATION

- A. Before installation, condition paneling to humidity conditions in installation areas.
- B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.02 INSTALLATION

- A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

- B. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch (3.18 mm) in 96 inches (2438.4 mm). Install with no more than 1/16 inch (1.59 mm) in 96-inch (0.06 inch (1.6 mm) in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (0.12 inch (3 mm) in 2400-mm) horizontal variation from a true plane.
 - 1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch (0.79 mm).
- C. Anchor paneling to supporting substrate with concealed panel-hanger clips.
 - 1. Do not use face fastening unless covered by trim.
 - 2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.
- D. See Section 099300 "Staining and Transparent Finishing" for final finishing of installed paneling.

3.03 ADJUSTING AND CLEANING

- A. Repair damaged and defective paneling, where possible, to eliminate defects. Where not possible to repair, replace paneling. Adjust for uniform appearance.
- B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

**SECTION 06 6400
PLASTIC PANELING**

SUMMARY

1.01 SECTION INCLUDES:

- A. Plastic sheet paneling.

1.02 RELATED REQUIREMENTS:

- A. Section 061000 "Rough Carpentry" for wood furring for installing plastic paneling.

ACTION SUBMITTALS

2.01 PRODUCT DATA: FOR EACH TYPE OF PRODUCT.

2.02 SAMPLES FOR VERIFICATION:

- A. 6"x6" sample of each specified product with trim pieces
- B. Cut Sheets of each specified panel type, trim and accessory.

QUALITY ASSURANCE

3.01 TESTING AGENCY: ACCEPTABLE TO AUTHORITIES HAVING JURISDICTION.

PROJECT CONDITIONS

4.01 ENVIRONMENTAL LIMITATIONS: DO NOT DELIVER OR INSTALL PLASTIC PANELING UNTIL SPACES ARE ENCLOSED AND WEATHERTIGHT AND TEMPORARY HVAC SYSTEM IS OPERATING AND MAINTAINING AMBIENT TEMPERATURE AND HUMIDITY CONDITIONS AT OCCUPANCY LEVELS DURING THE REMAINDER OF THE CONSTRUCTION PERIOD.

PART 1 PRODUCTS

5.01 SOURCE LIMITATIONS

5.02 OBTAIN PLASTIC PANELING AND TRIM ACCESSORIES FROM SINGLE MANUFACTURER.

PLASTIC SHEET PANELING

6.01 GLASS-FIBER-REINFORCED PLASTIC PANELING: GELCOAT-FINISHED, GLASS-FIBER-REINFORCED PLASTIC PANELS COMPLYING WITH ASTM D5319. PANELS ARE TO BE USDA ACCEPTED FOR INCIDENTAL FOOD CONTACT.

- A. Basis of Design: Marlite Standard P100. Reference Sheet A700.
- B. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Nominal Thickness: Not less than 3/32"
- D. Surface Finish: Molded pebble texture
- E. Color: White
- F. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

ACCESSORIES

7.01 TRIM ACCESSORIES: MANUFACTURER'S STANDARD ONE-PIECE VINYL EXTRUSIONS DESIGNED TO RETAIN AND COVER EDGES OF PANELS. PROVIDE DIVISION BARS, INSIDE CORNERS, OUTSIDE CORNERS, AND CAPS AS NEEDED TO CONCEAL EDGES.

- A. Color: White

- 7.02 EXPOSED FASTENERS: NYLON DRIVE RIVETS RECOMMENDED BY PANEL MANUFACTURER.**
- 7.03 CONCEALED MOUNTING SPLINES: CONTINUOUS, H-SHAPED ALUMINUM EXTRUSIONS DESIGNED TO FIT INTO GROOVES ROUTED IN EDGES OF FACTORY-LAMINATED PANELS AND TO BE FASTENED TO SUBSTRATE.**
- 7.04 ADHESIVE: AS RECOMMENDED BY PLASTIC PANELING MANUFACTURER.**
- 7.05 SEALANT: MILDEW-RESISTANT, SINGLE-COMPONENT, NEUTRAL-CURING SILICONE SEALANT RECOMMENDED BY PLASTIC PANELING MANUFACTURER AND COMPLYING WITH REQUIREMENTS IN SECTION 079200 "JOINT SEALANTS."**

PART 2 EXECUTION

8.01 EXAMINATION

- 8.02 EXAMINE SUBSTRATES AND CONDITIONS, WITH INSTALLER PRESENT, FOR COMPLIANCE WITH REQUIREMENTS FOR INSTALLATION TOLERANCES AND OTHER CONDITIONS AFFECTING PERFORMANCE OF THE WORK.**
- 8.03 PROCEED WITH INSTALLATION ONLY AFTER UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.**

PREPARATION

- 9.01 REMOVE WALLPAPER, VINYL WALL COVERING, LOOSE OR SOLUBLE PAINT, AND ANY OTHER MATERIALS THAT MIGHT INTERFERE WITH ADHESIVE BOND.**
- 9.02 PREPARE SUBSTRATE BY SANDING HIGH SPOTS AND FILLING LOW SPOTS AS NEEDED TO PROVIDE FLAT, EVEN SURFACE FOR PANEL INSTALLATION.**
- 9.03 CLEAN SUBSTRATES OF SUBSTANCES THAT COULD IMPAIR ADHESIVE BOND, INCLUDING OIL, GREASE, DIRT, AND DUST.**
- 9.04 CONDITION PANELS BY UNPACKING AND PLACING IN INSTALLATION SPACE BEFORE INSTALLATION ACCORDING TO MANUFACTURER'S WRITTEN RECOMMENDATIONS.**
- 9.05 LAY OUT PANELING BEFORE INSTALLING. LOCATE PANEL JOINTS TO PROVIDE EQUAL PANELS AT ENDS OF WALLS NOT LESS THAN HALF THE WIDTH OF FULL PANELS SO THAT TRIMMED PANELS AT CORNERS ARE NOT LESS THAN 12 INCHES (304.8 MM) WIDE.**
 - A. Mark plumb lines on substrate at panel joint locations for accurate installation.
 - B. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

INSTALLATION

- 10.01 INSTALL PLASTIC PANELING ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS.**
- 10.02 INSTALL PANELS IN A FULL SPREAD OF ADHESIVE.**
- 10.03 FILL GROOVES IN TRIM ACCESSORIES WITH SEALANT BEFORE INSTALLING PANELS, AND BED INSIDE CORNER TRIM IN A BEAD OF SEALANT.**
- 10.04 MAINTAIN UNIFORM SPACE BETWEEN PANELS AND WALL FIXTURES. FILL SPACE WITH SEALANT.**
- 10.05 REMOVE EXCESS SEALANT AND SMEARS AS PANELING IS INSTALLED. CLEAN WITH SOLVENT RECOMMENDED BY SEALANT MANUFACTURER AND THEN WIPE WITH CLEAN DRY CLOTHS UNTIL NO RESIDUE REMAINS.**

END OF SECTION

SECTION 07 9200 JOINT SEALANTS

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. Silicone joint sealants.
 - 2. Latex joint sealants.
 - 3. Acoustical joint sealants.
- B. Related Sections:
 - 1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
 - 2. Division 07 Section "Expansion Control - Interior" for interior building expansion joints.
 - 3. Division 08 Section "Glazing" for glazing sealants.
 - 4. Division 09 Section "Gypsum Board" for sealing perimeter joints.
 - 5. Division 09 Section "Tiling" for sealing tile joints.

1.03 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- D. Field-Adhesion Test Reports: For each sealant application tested.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.05 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.06 WARRANTY

- A. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Omniseal 50.
 - b. Dow Corning Corporation; 756 SMS.
 - c. GE Advanced Materials - Silicones; SilPruf NB SCS9000.
 - d. May National Associates, Inc.; Bondaflex Sil 295.
 - e. Pecora Corporation; 864.
 - f. Polymeric Systems, Inc.; PSI-641.
 - g. Sika Corporation, Construction Products Division; SikaSil-C995.
 - h. Tremco Incorporated; Spectrem 2.
- B. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. May National Associates, Inc.; Bondaflex Sil 728 NS.
- C. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 1. Products: Subject to compliance with requirements:
 - a. Pecora Corporation; 898.
- D. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Omniplus.
 - b. Dow Corning Corporation; 786 Mildew Resistant.
 - c. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - d. May National Associates, Inc.; Bondaflex Sil 100 WF.
 - e. Tremco Incorporated; Tremsil 200 Sanitary.

2.03 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. May National Associates, Inc.; Bondaflex Sil-A 700.
 - d. Pecora Corporation; AC-20+.
 - e. Schnee-Morehead, Inc.; SM 8200.
 - f. Tremco Incorporated; Tremflex 834.

2.04 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. ATS Acoustics; QuietSeal Pro Acoustical Sealant.
 - c. Auralex; StopGap Acoustical Sealant.
 - d. Grabber Construction Products; Acoustical Sealant GSC.
 - e. Pecora Corporation; AC-20 FTR.
 - f. USG Corporation; SHEETROCK Acoustical Sealant.

2.05 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type B (bicellular material with a surface skin) or either of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.06 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
 - e. Joints between dissimilar nonporous surfaces.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to

form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.04 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform a minimum of 2 tests for the first 100 feet (3048 cm) of joint length for each kind of sealant and joint substrate.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite

such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. At transitions between flooring and expansion control assemblies as required.
 - d. Other joints as indicated.
 - 2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.
 - 3. Joint Sealant: Single-Component,, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant.
 - 4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Perimeter joints of exterior openings where indicated.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of interior unit masonry and concrete.
 - d. Perimeter joints between interior wall surfaces not scheduled to receive coatings and frames of interior doors, windows, and elevator entrances.
 - e. Joints between dissimilar or similar nonporous substrates not subject to traffic.
 - f. Other joints as indicated.
 - 2. Joint Sealant: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant.
 - 3. Joint-Sealant Colors: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Joints on exposed surfaces of interior painted surfaces.
 - b. Perimeter joints between painted interior wall surfaces and frames of interior doors, windows, and elevator entrances.
 - c. Other joints as indicated.
 - 2. Joint Sealant: Latex.
 - 3. Joint-Sealant Color: Match Architect's sample to blend with adjacent paint or be painted over.
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints in wet areas.
 - 2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing Silicone or Single component, nonsag, mildew resistant, acid curing Silicone.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Location:
 - a. Acoustical joints where indicated.
 - b. Other joints as indicated.
 - 2. Joint Sealant: Acoustical.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- F. Joint-Sealant Application: Exterior control joints in vertical surfaces.
 - 1. Joint Locations:

- a. Control joints in exposed exterior masonry
- b. Other joints as indicated.
2. Joint Sealant: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant.
3. Joint-Sealant Colors: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

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**SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES**

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. Standard hollow metal doors and frames.

1.03 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.
- C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Other Action Submittals:
 - 1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
- D. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to finish of factory-finished units.

- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.08 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
 - 1. Air Barrier: Coordinate installation of anchors prior to application of air barrier on exterior wall assemblies where applicable.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Division 08 Section "Glazing."

2.02 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polyurethane, polyisocyanurate, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge.

- a. Beveled Edge: 1/8 inch (3.18 mm) in 2 inches (50.8 mm).
 4. Top and Bottom Edges: Closed with flush 0.042-inch- thick, end closures or channels of same material as face sheets.
 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.03 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Interior Frames: Fabricated from cold-rolled steel sheet.
1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as full profile welded unless otherwise indicated.
 3. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
 4. Frames for Level 4 Steel Doors: 0.067-inch- thick steel sheet.
 5. Frames for Wood Doors: 0.053-inch- thick steel sheet.
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.04 FRAME ANCHORS

- A. Jamb Anchors:
1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.07 mm) thick, with corrugated or perforated straps not less than 2 inches (50.8 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.07 mm) thick.
 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.07 mm) thick, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.05 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.81 mm) thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (15.88 mm) high unless otherwise indicated.

2.06 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches (457.2 mm) from top and bottom of frame. Space anchors not more than 32 inches (812.8 mm) o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (3048 mm) high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (609.6 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457.2 mm) from top and bottom of frame. Space anchors not more than 32 inches (812.8 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2438.4 mm) high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (609.6 mm) or fraction thereof above 96 inches (2438.4 mm) high.
 - 5) Two anchors per head for frames above 42 inches (1066.8 mm) wide and mounted in metal-stud partitions.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152.4 mm) from top and bottom of frame. Space anchors not more than 26 inches o.c.
 5. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - a. Reinforcement for door hardware for Level 4 Steel Doors shall be 12 ga. steel minimum.
 2. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 - 2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 3. Provide loose stops and moldings on inside of hollow metal work.

2.07 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch (1.59 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch (1.59 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch (1.59 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch (1.59 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.

- f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.59 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.59 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.59 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.59 mm), measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3.18 mm) plus or minus 1/16 inch (1.59 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.18 mm) plus or minus 1/16 inch (1.59 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.52 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19.05 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (228.6 mm) o.c. and not more than 2 inches (50.8 mm) o.c. from each corner.

3.04 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

**SECTION 08 1416
FLUSH WOOD DOORS**

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. Solid-core doors with wood-veneer faces.

1.03 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate fire-protection ratings for fire-rated doors.
- C. Samples for Initial Selection: Paint draw-downs for color and sheen selection.
- D. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors from single manufacturer.
- B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
 - 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch (6.35 mm) in a 42-by-84-inch section.

- b. Telegraphing of core construction in face veneers exceeding 0.01 inch (0.25 mm) in a 3-inch span.
2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 DOOR CONSTRUCTION, GENERAL

- A. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 1. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Comply with specified requirements for exposed edges.
- B. Mineral-Core Doors:
 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.03 VENEERED-FACED DOORS FOR PAINTED FINISH

- A. Interior Solid-Core Doors:
 1. Grade: Paint-grade.
 2. Species: Birch.
 3. Exposed Vertical Edges: Same species as faces.
 4. Core: Structural composite lumber.
 5. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.

2.04 LOUVERS AND LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
 1. Wood Species: Same species as door faces.
 2. Profile: Flush rectangular beads.
 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.

2.05 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 1. Clearances: Provide 1/8 inch (3.18 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.35 mm) from bottom of door to top of threshold unless otherwise indicated.
 2. Bevel non-fire-rated doors 1/8 inch (3.18 mm) in 2 inches (50.8 mm) at lock and hinge edges.
 3. Bevel fire-rated doors 1/8 inch (3.18 mm) in 2 inches (50.8 mm) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

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**SECTION 08 3113
INTERIOR ACCESS DOORS AND FRAMES**

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. Access doors and frames for walls and ceilings.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Samples: For each door face material, at least 3 by 5 inches (127 mm) in size, in specified finish.
- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.

2.02 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Acudor Products, Inc.
 - 2. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 3. Karp Associates, Inc.
 - 4. Larsen's Manufacturing Company.
 - 5. Metropolitan Door Industries Corp.
 - 6. Milcor Inc.
 - 7. Nystrom, Inc.
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Flush Access Doors with Exposed Flanges:
 - 1. Basis-of-Design Product: Acudor: UF-5000; Stainless Steel.
 - 2. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 - 3. Locations: Walls where tile or other finish materials will extend behind flanges.
 - 4. Door Size: As indicated on Drawings.
 - 5. Stainless-Steel Sheet for Door: Nominal 0.078 inch (1.98 mm), 14 gage.
 - a. Finish: No. 4.
 - 6. Frame Material: Same material, and finish as door; Nominal 0.062 inch (1.57 mm), 16 gage.

7. Hinges: Manufacturer's standard continuous, concealed.
 8. Hardware: Cylinder Lock.
- D. Flush Access Doors with Concealed Flanges:
1. Basis-of-Design Product: Acudor: BP58.
 2. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
 3. Locations: Gypsum board walls.
 4. Door Size: As indicated on Drawings.
 5. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
 - a. Finish: Factory primed for field finish of gypsum insert.
 6. Frame Material: Aluminum.
 7. Hinges: Concealed, non-corroding, two-point hinge. 120 degree opening, removable door.
 8. Hardware: Cylinder Lock.
- E. GFRG Drop-In Flush Access Doors:
1. Basis-of-Design Product: Acudor, Model Wind-Lock TR.
 2. Assembly Description: Fabricate door to fit flush to frame. Fabricate frame from single piece, with gypsum board bead for concealed installation.
 3. Locations: Ceiling.
 4. Door Size: Where required or as indicated on Drawings
 5. Door and Frame Materials: GFRG and Fiber Glass, 3/16 inch (4.76 mm) shell thickness.
- F. Fire-Rated, Flush Access Doors with Exposed Flanges:
1. Basis-of-Design Product: Acudor: FB-5060.
 2. Assembly Description: Fabricate door to fit flush to frame, uninsulated. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.
 3. Locations: Wall.
 4. Fire-Resistance Rating: Not less than that of adjacent construction.
 5. Uncoated Steel Sheet for Door: Manufacturer's standard.
 - a. Finish: Factory prime.
 6. Frame Material: Same material, thickness, and finish as door.
 7. Hinges: Manufacturer's standard.
 8. Hardware: Cylinder Lock.

2.03 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- E. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines or blend into finish.
- F. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- G. Aluminum Sheet: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2.
- H. Frame Anchors: Same type as door face.

- I. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.04 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 1. For concealed flanges with drywall bead, provide edge trim for gypsum board and gypsum base securely attached to perimeter of frames.
 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
 3. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. Cylinder: Core cylinder shall be keyed into existing Medeco X4 key system.
- E. Extruded Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.05 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.0254 mm) for topcoat.
- E. Stainless-Steel Finishes:
 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.
- F. Aluminum Finishes:
 1. Mill finish.
 2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0 inch (0.01 mm) or thicker.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.03 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

**SECTION 08 4113
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

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. Interior storefront framing.
 - 2. Exterior and interior manual-swing and power-assist entrance doors and door-frame units.
- B. Related Sections:
 - 1. Division 08 Section "Glazing" for monolithic-glass lites and insulating-glass units to be installed in entrances and storefront framing.

1.03 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.04 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.
- B. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.05 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.18 mm), whichever is smaller.
- C. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- D. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..

- E. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- F. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
 - 2. Interior Ambient-Air Temperature: 75 deg F.
- G. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
- C. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
- D. Other Action Submittals:
 - 1. Entrance Door Hardware Schedule: Coordinate with requirements of Division 08 Section "Door Hardware."
- E. Qualification Data: For qualified Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.
- G. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- H. Warranties: Sample of special warranties.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to

Architect for review.

- D. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- E. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water leakage through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. EFCO Corporation.
 - 2. Kawneer North America; an Alcoa company.
 - 3. Oldcastle.
 - 4. Pittco Architectural Metals, Inc.

2.02 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.

2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.03 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Construction: Nonthermal.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Center.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from stainless steel.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.04 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.05 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing and power-assisted operation.
 1. Door Construction: 2- to 2-1/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 2. Door Design: As indicated, with 5-inch minimum stile width for mortise hardware.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (254 mm) above floor or ground plane.
 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
- B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

2.06 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.07 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior, for exterior door frames.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
 - 1. Coordinate hardware with Division 08 Section "Door Hardware."
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.08 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0 inch (0.02 mm) or thicker.
 - 1. For exterior and interior vestibule entrance doors only.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0 inch (0.02 mm) or thicker.
 - 1. Color: Black
 - 2. For Laundry Room doors only.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 6. Seal joints watertight at exterior locations.

- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior, for exterior door frames.
- D. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- E. Install glazing as specified in Division 08 Section "Glazing."
- F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- G. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation at exterior door frames.

3.03 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch (3.18 mm) in 12 feet (365.76 cm); 1/4 inch (6.35 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.59 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.79 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3.18 mm).

3.04 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (76.2 mm) from the latch, measured to the leading door edge.

END OF SECTION

**SECTION 08 7100
DOOR HARDWARE**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

1.02 SUMMARY

- A. Section Includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
 - 3. Electrified door hardware.
- B. Related Requirements:
 - 1. Section 081213 "Hollow Metal Frames."
 - 2. Section 081216 "Aluminum Frames" for door silencers provided as part of aluminum frames.
 - 3. Section 081416 "Flush Wood Doors."
 - 4. Section 083113 "Access Doors and Frames" for access door hardware, including cylinders.
 - 5. Section 102600 "Wall and Door Protection" for plastic door protection units that match wall protection units.

1.03 COORDINATION

- A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.
 - 1. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.

1.05 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of electrified door hardware.
 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- B. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware schedule.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 1. Warehousing Facilities: In Project's vicinity.
 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.09 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Electromagnetic Locks: Five years from date of Substantial Completion.
 - b. Exit Devices: Two years from date of Substantial Completion.
 - c. Manual Closers: 10 years from date of Substantial Completion.
 - d. Concealed Floor Closers: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested in accordance with UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" and the 2012 Texas Accessibility Standards.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (12.7 mm) high.
 - 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
 - 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.03 HINGES

- A. Hinges: BHMA A156.1.
 - 1. Ives.
 - 2. Hager.

2.04 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (101.6 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
 - 1. Ives.
 - 2. Hager.

2.05 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.
- D. Lock Trim:
 - 1. Levers: Wrought.
 - a. Best Locks 93K - No Substitution.s
 - b. Schlage L Locks
 - 2. Escutcheons (Roses): Wrought.
 - 3. Dummy Trim: Match lever lock trim and escutcheons.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 - 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- F. Mortise Locks: BHMA A156.13; Operational Grade 1; Series Schlage L
 - 1. Schlage L Locks.
- G. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
 - 1. Best Lock - No Substitution.

2.06 SELF-LATCHING FLUSH BOLTS

- A. Self-Latching Flush Bolts: BHMA A156.3, Type 27; minimum 3/4-inch (19-mm) throw; with dust-proof strikes; designed for mortising into door edge. Include wear plates.
 - 1. Ives.
 - 2. Quality.
 - 3. Trimco.

2.07 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
 - 1. Von Duprin 33/99 - No Substitution.

2.08 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.
 - 1. Core Type: Interchangeable.
- C. High-Security Lock Cylinders: BHMA A156.30; Grade 1 permanent cores that are removable; face finished to match lockset.
 - 1. Type: M, mechanical.
- D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.09 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
 - 1. No Master Key System: Only change keys operate cylinders.
 - a. Provide three cylinder change keys.
 - 2. Master Key System: Change keys and a master key operate cylinders.
 - a. Provide three cylinder change keys and five master keys.
 - 3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
 - a. Provide three cylinder change keys and five each of master and grand master keys.
 - 4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
 - a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.
 - 5. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
 - 6. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."

2.10 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
 - 1. Multiple-Drawer Cabinet: Grade 1 cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.
 - 2. Wall-Mounted Cabinet: Grade 1 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
 - 3. Portable Cabinet: Grade 1 tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

2.11 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; aluminum, unless otherwise indicated.
 - 1. Von Duprin 996L - No substitution.

2.12 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22.

2.13 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. LCN 4040XP - No substitution.

2.14 MECHANICAL STOPS AND HOLDERS

- A. Wall and Floor-Mounted Stops: BHMA A156.16.
 - 1. Glynn-Johnson.
 - 2. Ives.
 - 3. Quality.

2.15 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
 - 1. Glynn-Johnson.

2.16 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 - 1. Zero International.
 - 2. Pemko.
 - 3. Reese Metal Weatherstripping.
- B. Maximum Air Leakage: When tested in accordance with ASTM E283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:
 - 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
 - 2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
 - 3. Gasketing on Double Doors: 0.50 cfm per ft. (0.000774 cu. m/s per m) of door opening.

2.17 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. Zero International.
 - 2. Pemko.
 - 3. Reese Metal Weatherstripping.

2.18 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick aluminum; with manufacturer's standard machine or self-tapping screw fasteners.
 - 1. Ives
 - 2. Baldwin Hardware Manufacturing Corporation

2.19 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.20 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.03 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (762 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (762 mm) of door height greater than 90 inches (2286 mm).
- E. Lock Cylinders: Owner will install all permanent cores. Contractor should request keying instructions from UNT Access Control a minimum of eight (8) weeks in advance of installation to provide factory pin cores for UNT. Contractor should order and deliver uncut keys and uncombined cores to UNT Facilities for orders of 20 or fewer cores.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
 - 1. Configuration: Provide one power supply for each door opening with electrified door hardware.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.05 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to

operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.06 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.07 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.08 DEMONSTRATION

- A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.09 DOOR HARDWARE SCHEDULE

124858 OPT0404568 VERSION 4

HW SET# 201

DOOR #(S):

A127

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	93K-7D-15D-S3	626	BES
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN

1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HW SET# 207

DOOR #(S):
 A128 A137

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	93K-7D-15D-S3	626	BES
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	SCH
1	EA	OH STOP	900S SERIES X SIZE & MTG AS REQ	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HW SET# 401

DOOR #(S):
 A122 A123

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE LATCH	93K-ON-15D-S3	626	BES
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
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HW SET# 501W

DOOR #(S):
A136

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	93K-7R-15D-S3	626	BES
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

HW SET# 701

DOOR #(S):
A126

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-L-06 LENGTH AS REQ	626	VON
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	SCH
1	EA	RIM CYLINDER	MATCH EXISTING	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN

1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET #201AC

DOOR #(S):

A140					
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	STOREROOM LOCK	93K-7D-15D-S3	626	BES
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		

HW SET# EX-207

DOOR #(S):

E-A117

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	93K-7D-15D-S3	626	BES
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	SCH
1	EA	OH STOP	900S SERIES X SIZE & MTG AS REQ	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

****EXISTING DOOR THIS HARDWARE SET IS BASED ON A NEW DOOR AND IS BASED OFF THE PERFORMANCE AND SECURITY NEEDS REQUIRED****

-GC & SUPPLIER TO SURVEY EXISTING DOORS TO DETERMINE DOOR, FRAME & HARDWARE CONDITIONS.

-IF NEW HARDWARE IS REQUIRED, COORDINATE CURRENT DOOR AND FRAME PREPS WITH SPECIFIED HARDWARE.

-DO NOT ORDER NEW HARDWARE FOR THIS OPENING UNTIL THE SURVEY IS COMPLETED.

HW SET# EX-341

**DOOR #(S):
 E-A118**

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV 488S PSA H & J	630	IVE
1	EA	GASKETING	(USE SILENCERS @ NON-RATED DOORS)	BK	ZER

****EXISTING DOOR THIS HARDWARE SET IS BASED ON A NEW DOOR AND IS BASED OFF THE PERFORMANCE AND SECURITY NEEDS REQUIRED****

-GC & SUPPLIER TO SURVEY EXISTING DOORS TO DETERMINE DOOR, FRAME & HARDWARE CONDITIONS.

-IF NEW HARDWARE IS REQUIRED, COORDINATE CURRENT DOOR AND FRAME PREPS WITH SPECIFIED HARDWARE.

-DO NOT ORDER NEW HARDWARE FOR THIS OPENING UNTIL THE SURVEY IS COMPLETED.

HW SET# EX-711CR

**DOOR #(S):
 E-A106**

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	99-L-NL-F-06 LENGTH AS REQ	626	VON
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	SCH

1	EA	RIM CYLINDER	MATCH EXISTING 4040XP SCUSH	626	SCH
1	EA	SURFACE CLOSER	X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J	BK	ZER

****EXISTING DOOR THIS HARDWARE SET IS BASED ON A NEW DOOR AND IS BASED OFF THE PERFORMANCE AND SECURITY NEEDS REQUIRED****

-GC & SUPPLIER TO SURVEY EXISTING DOORS TO DETERMINE DOOR, FRAME & HARDWARE CONDITIONS.

-IF NEW HARDWARE IS REQUIRED, COORDINATE CURRENT DOOR AND FRAME PREPS WITH SPECIFIED HARDWARE.

-DO NOT ORDER NEW HARDWARE FOR THIS OPENING UNTIL THE SURVEY IS COMPLETED.

HW SET# EX-715A

**DOOR #(S):
E-A122**

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	FIRE EXIT HARDWARE	99-L-NL-F-06 LENGTH AS REQ	626	VON
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM	626	SCH
1	EA	RIM CYLINDER	MATCH EXISTING 4040XP SCUSH	626	SCH
1	EA	SURFACE CLOSER	X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR		

****EXISTING DOOR THIS HARDWARE SET IS BASED ON A NEW DOOR AND IS BASED OFF THE PERFORMANCE AND SECURITY NEEDS REQUIRED****

-GC & SUPPLIER TO SURVEY EXISTING DOORS TO DETERMINE DOOR, FRAME & HARDWARE CONDITIONS.

-IF NEW HARDWARE IS REQUIRED, COORDINATE CURRENT DOOR AND FRAME PREPS WITH SPECIFIED HARDWARE.

-DO NOT ORDER NEW HARDWARE FOR THIS OPENING UNTIL THE SURVEY IS COMPLETED.

HW SET# EX-C201C

**DOOR #(S):
E-A119**

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
-----	--	-------------	----------------	--------	-----

2	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	~	652	IVE
1	EA	EU STOREROOM LOCK	93K-7DEU-15D-S3	~	626	BES
1	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS 488S PSA H & J (USE		630	IVE
1	EA	GASKETING	SILENCERS @ NON-RATED DOORS) ALLEGION CONNECT		BK	ZER
1	EA	WIRE HARNESS (IN DOOR)	TYPE & LENGTH AS REQ	~		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS	~		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY SECURITY CONTRACTOR	~		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ PS902 900-2RS 120/240 VAC	~	BLK	SCE
1	EA	POWER SUPPLY	(OMIT 2RS BOARD WHERE NOT REQ)	~	LGR	SCE

****EXISTING DOOR THIS HARDWARE SET IS BASED ON A NEW DOOR AND IS BASED OFF THE PERFORMANCE AND SECURITY NEEDS REQUIRED****

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-IF NEW HARDWARE IS REQUIRED, COORDINATE CURRENT DOOR AND FRAME PREPS WITH SPECIFIED HARDWARE.

-DO NOT ORDER NEW HARDWARE FOR THIS OPENING UNTIL THE SURVEY IS COMPLETED.

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY LEVER.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

-OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HW SET# EX-C710AM

DOOR #(S):

EC120.2

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY EPT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON	~	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB HEIGHT AS REQ		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-EO-CON LENGTH AS REQ	~	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-OP-CON LENGTH AS REQ	~	626	VON
2	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM		626	SCH
1	EA	MORTISE CYLINDER	MATCH EXISTING		626	SCH
1	EA	RIM CYLINDER	MATCH EXISTING		626	SCH
2	EA	90 DEG OFFSET PULL	8190-O 10"		630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	MULLION SEAL	8780NBK PSA PERIMETER		BK	ZER
1	SET	SEAL	SEAL BY FRAME MFR			

1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MFR ALLEGION			
4	EA	WIRE HARNESS (1 IN DOOR & 1 IN FRAME)	CONNECT TYPE & LENGTH AS REQ	~		SCH
2	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS	~		SCH
1	EA	MULTITECH READER	MTMS15	~	BLK	SCE
2	EA	DOOR CONTACT	679-05 TYPE AS REQ POWER SUPPLY FOR CREDENTIAL READER BY SECURITY CONTRACTOR PS902 900-4RL 120/240 VAC	~	BLK	SCE
1	EA	POWER SUPPLY	(OMIT 4RL BOARD WHERE NOT REQ)	~		VON

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-DO NOT ORDER NEW HARDWARE FOR THIS OPENING UNTIL THE SURVEY IS COMPLETED.

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE PUSH PAD.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

-OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HW SET# EX-C714AM

**DOOR #(S):
 EC120.1**

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY EPT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON	~	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB HEIGHT AS REQ		689	VON

1	EA	ELEC PANIC HARDWARE	RX-QEL-99- EO-CON LENGTH AS REQ	~	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99- NL-OP-CON LENGTH AS REQ	~	626	VON
2	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM		626	SCH
1	EA	MORTISE CYLINDER	MATCH EXISTING		626	SCH
1	EA	RIM CYLINDER	MATCH EXISTING		626	SCH
2	EA	90 DEG OFFSET PULL	8190-O 10"		630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	MULLION SEAL	8780NBK PSA PERIMETER SEAL BY FRAME MFR MEETING		BK	ZER
1	SET	SEAL	STILE SEAL BY DOOR MFR ALLEGION			
4	EA	WIRE HARNESS (1 IN DOOR & 1 IN FRAME)	CONNECT TYPE & LENGTH AS REQ	~		SCH
2	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS	~		SCH
1	EA	MULTITECH READER	MTMS15	~	BLK	SCE
2	EA	DOOR CONTACT	679-05 TYPE AS REQ POWER SUPPLY FOR CREDENTIAL READER BY SECURITY CONTRACTOR	~	BLK	SCE
1	EA	POWER SUPPLY	PS902 900- 4RL 120/240	~		VON

VAC
 (OMIT 4RL
 BOARD
 WHERE NOT
 REQ)

****EXISTING DOOR THIS HARDWARE SET IS BASED ON A NEW DOOR AND IS BASED OFF THE PERFORMANCE AND SECURITY NEEDS REQUIRED****

-GC & SUPPLIER TO SURVEY EXISTING DOORS TO DETERMINE DOOR, FRAME & HARDWARE CONDITIONS.

-IF NEW HARDWARE IS REQUIRED, COORDINATE CURRENT DOOR AND FRAME PREPS WITH SPECIFIED HARDWARE.

-DO NOT ORDER NEW HARDWARE FOR THIS OPENING UNTIL THE SURVEY IS COMPLETED.

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE PUSH PAD.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

-OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HW SET# EX-C714M

**DOOR #(S):
 A135**

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
2	EA	POWER TRANSFER	EPT10 CON	~	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB HEIGHT AS REQ		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-L- DT-06-CON 24 VDC	~	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-L- NL-06-CON 24 VDC	~	626	VON
2	EA	PERMANENT CORE	MATCH EXISTING KEY SYSTEM		626	SCH
1	EA	MORTISE CYLINDER	MATCH EXISTING		626	SCH
1	EA	RIM CYLINDER	MATCH EXISTING 4040XP		626	SCH
1	EA	SURFACE CLOSER	SCUSH X MTG BRKT, SPCR & PLATE AS REQ		689	LCN
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	SET	SEAL	PERIMETER SEAL BY			

1	SET	ASTRAGAL	FRAME MFR MEETING STILE SEAL BY DOOR MFR ALLEGION			
4	EA	WIRE HARNESS (1 IN DOOR & 1 IN FRAME)	CONNECT TYPE & LENGTH AS REQ	~		SCH
2	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS	~		SCH
1	EA	MULTITECH READER	MTMS15	~	BLK	SCE
2	EA	DOOR CONTACT	679-05 TYPE AS REQ POWER SUPPLY FOR CREDENTIAL READER BY SECURITY CONTRACTOR PS902 900-4RL 120/240 VAC	~	BLK	SCE
1	EA	POWER SUPPLY	(OMIT 4RL BOARD WHERE NOT REQ)	~		VON

****EXISTING DOOR THIS HARDWARE SET IS BASED ON A NEW DOOR AND IS BASED OFF THE PERFORMANCE AND SECURITY NEEDS REQUIRED****

-GC & SUPPLIER TO SURVEY EXISTING DOORS TO DETERMINE DOOR, FRAME & HARDWARE CONDITIONS.

-IF NEW HARDWARE IS REQUIRED, COORDINATE CURRENT DOOR AND FRAME PREPS WITH SPECIFIED HARDWARE.

-DO NOT ORDER NEW HARDWARE FOR THIS OPENING UNTIL THE SURVEY IS COMPLETED.

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE PUSH PAD.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

-OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

SCHEDULE A DOOR HARDWARE SET FOR EACH UNIQUE DOOR HARDWARE CONFIGURATION REQUIRED FOR PROJECT. IDENTIFY EACH SET WITH A UNIQUE NUMBER DESIGNATION. SEE "SAMPLE DOOR HARDWARE SCHEDULES" ARTICLE IN THE EVALUATIONS FOR ADDITIONAL INFORMATION.

END OF SECTION

**SECTION 08 8000
GLAZING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section includes:
 - 1. Glass for glazed storefront at hydroponic enclosure and banquette seating .
 - 2. Glazing sealants and accessories.

1.04 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.

1.05 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.06 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.07 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass, including the following products; 12 inches (304.8 mm) square.
 - 1. Laminated glass.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

1.08 QUALITY ASSURANCE

- A. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees Fahrenheit (4.44 degrees Celsius) .

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:
 - 1. Cardinal Glass Industries.
 - 2. Guardian Industries Corp.; SunGuard.
 - 3. Pilkington North America.
 - 4. PPG Industries, Inc.
 - 5. Viracon, Inc.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.02 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Safety Glazing: Provide glazing that complies with 16 CFR 1201, Category II.

2.03 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of, the SGCC or another certification agency acceptable to authorities having jurisdiction, or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass. Where heat-strengthened float glass is

indicated, provide heat-strengthened float glass or fully tempered float glass. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.04 GLASS PRODUCTS

- A. Ultraclear Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent.
 - 1. Basis-of-Design Product: PPG; "Starphire."
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.05 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer,, to comply with interlayer manufacturer's written instructions.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Clear.

2.06 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
 - 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

2.07 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.08 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces (arris edge).
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Minimum required face and edge clearances.
 - 3. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.03 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) .
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.05 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.06 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.07 MONOLITHIC GLASS SCHEDULE

- A. Glass Type GL-1: Ultraclear fully tempered float glass.
 - 1. Basis-of-Design Product: PPG Industries, Inc.; Starphire.
 - 2. Minimum Thickness: 0.24 inch (6 mm).
 - 3. Safety glazing required.

3.08 LAMINATED GLASS SCHEDULE

- A. Glass Type LGL-1: Clear laminated glass with two plies of ultraclear fully tempered float glass.
 - 1. Product: Dining Partition and Hydroponic Enclosure Glazing.
 - 2. Minimum Thickness of Each Glass Ply: As indicated, 0.24 inch (6 mm) and 0.39 inch (10 mm).
 - 3. Interlayer Thickness: 0.045 inch (1.14 mm).
 - 4. Safety glazing required.

END OF SECTION

**SECTION 09 2216
NON-STRUCTURAL METAL FRAMING**

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. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For dimpled steel studs and runners and firestop tracks, from ICC-ES.

1.05 QUALITY ASSURANCE

- A. All vibration isolation shall be by a single manufacturer.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.02 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.
 - 1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 - b. Depth: As indicated on Drawings.
 - 2. Dimpled Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (304.8 mm) of the top of studs to provide lateral bracing.
 - 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) MBA Building Supplies; FlatSteel Deflection Track or Slotted Deflecto Track.
 - 3) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
 - 4) Superior Metal Trim; Superior Flex Track System (SFT).
 - 5) Telling Industries; Vertical Slip Track or Vertical Slip Track II.
- D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.
 - d. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
- F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
1. Depth: 1-1/2 inches (38 mm).
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 mm), 0.068-inch- thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.018 inch (0.46 mm).
 2. Depth: 7/8 inch (22.22 mm).
- H. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical or hat shaped.
- I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.
1. Depth: 3/4 inch (19.05 mm).
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.84 mm).
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

2.03 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Postinstalled, expansion anchor.
 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Resilient Hangers:

1. Heavy Duty: Provide units with static deflection of 0.3 inches (7.62 mm) minimum.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Mason Industries: Type HD with double deflection LDS rubber element.
 - 2) Kinetics Noise Control, Inc.: Model RH with elastomeric-in-shear resilient element.
 - b. Installation: Arrange for wire hanging.
 - c. Locations: Provide at Second Floor locations of Sound Control Ceilings.
 2. Standard Duty: Provide units with static deflection of 0.15 inches (3.81 mm) minimum.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Mason Industries: Type WHR with LDS rubber element.
 - 2) Kinetics Noise Control, Inc.: Model IsoGrid-150 with double deflection neoprene element.
 - 3) Kinetics Noise Control, Inc.: Model AF-200 with fiberglass element.
 - b. Installation: Arrange for wire hanging or direct connection to concrete slab above.
 - c. Location: Provide at locations other than the Second Floor Sounds Control Ceilings.
 3. High Bay: Provide units with static deflection of 0.3 inches (7.62 mm) minimum.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Mason Industries: Type 30N.
- D. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.06 mm) in diameter.
- E. Flat Hangers: Steel sheet, 1 by 3/16 inch (4.76 mm) by length indicated.
- F. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.35 mm) and minimum 1/2-inch- wide flanges.
 1. Depth: As indicated on Drawings.
- G. Furring Channels (Furring Members):
 1. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.018 inch (0.46 mm).
 - b. Depth: As indicated on Drawings.
- H. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.04 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.18 mm) thick, in width to suit steel stud size.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.03 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches (406.4 mm) o.c. unless otherwise indicated.
 - 2. Multilayer Application: 16 inches (406.4 mm) o.c. unless otherwise indicated.
 - 3. Tile Backing Panels: 16 inches (406.4 mm) o.c. unless otherwise indicated. Use only 0.033 inch (0.84 mm) base metal thickness framing members behind cementitious tile backer units.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated. Use only 0.033 inch (0.84 mm) base metal thickness framing members at jamb studs.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Where walls to not extend to structure above, extend jamb studs and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Z-Furring Members:
 - 1. Erect insulation where indicated, as specified in Division 07 Section "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches (609.6 mm) o.c.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (609.6 mm) o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring

channel to web of attached channel. At interior corners, space second member no more than 12 inches (304.8 mm) from corner and cut insulation to fit.

- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3.18 mm) from the plane formed by faces of adjacent framing.

3.04 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches (1219.2 mm) o.c.
 2. Carrying Channels (Main Runners): 48 inches (1219.2 mm) o.c.
 3. Furring Channels (Furring Members): 16 inches (406.4 mm) o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch (3.18 mm) in 12 feet (365.76 cm) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.05 SUSPENSION SYSTEM AT SOUND CONTROL CEILING

- A. Comply with resilient hanger manufacturer's written instructions for installing hanger and sound control ceiling system.
- B. Coordinate installation with other trades to eliminate rigid connections between sound control ceiling system and building structure.
- C. Install resilient (isolation) hangers vertical and that they do not rub against pipe, duct, ceiling beams or other interferences.
- D. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and resilient hangers in the form of trapezes or equivalent devices.

- a. Size supplemental suspension members and resilient hangers to support ceiling loads within performance limits established by referenced installation standards.

END OF SECTION

**SECTION 09 2900
GYPSUM BOARD**

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. Interior gypsum board.
 - 2. Tile backing panels.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.05 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.02 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.03 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Georgia-Pacific Gypsum LLC.
 - a. Interior Partitions and Ceilings: ToughRock® Mold-Guard™
 - b. Interior Side of Exterior Walls: DensArmorPlus®
 - 2. National Gypsum Company.

- a. Interior Partitions and Ceilings Gold Bond® XP® Gypsum Board
- b. Interior Side of Exterior Walls: Gold Bond® eXP® Interior Extreme®
3. USG Corporation.
 - a. Interior Partitions and Ceilings: Sheetrock® Brand Mold Tough® Gypsum Panels
 - b. Interior Side of Exterior Walls: Sheetrock® Brand Glass-Mat Panels Mold Tough®
- B. Gypsum Wallboard: Type X: ASTM C 1396
 1. Thickness: 5/8 inch (15.88 mm).
 2. Long Edges: Tapered.
- C. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 2.
 1. Core: 5/8 inch (15.88 mm), Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10.

2.04 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. James Hardie Building Products, Inc.; Hardiebacker.
 - b. National Gypsum Company, Permapase Cement Board.
 - c. USG Corporation; DUROCK Cement Board.
 2. Thickness: 5/8 inch (15.88 mm).
 3. Mold Resistance: ASTM D 3273, score of 10.

2.05 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 1. Material: Vinyl complying with ASTM D-1784.
 2. Shapes: Provide vinyl trim with perforated flanges for embedding in finishing compound. Provide in the following shapes or as shown:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 1. Premanufactured Moldings: Provide metal molding at installations as indicated in Drawings.
 - a. Trim at transition from gyp to brick where indicated: Fry Reglet Drywall J Molding or equivalent.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 3. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
 4. Finish: Clear anodized aluminum.
 5. Accessories: Factory-fabricated corner, intersection, and door frame closure trim pieces.

2.06 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Tile Backing Panels:
 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.07 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (2.84 mm) thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. ATS Acoustics; QuietSeal Pro Acoustical Sealant.
 - c. Auralex; StopGap Acoustical Sealant.
 - d. Grabber Construction Products; Acoustical Sealant GSC.
 - e. Pecora Corporation; AC-20 FTR.
 - f. USG Corporation; SHEETROCK Acoustical Sealant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.

- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.59 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.03 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Abuse-Resistant Type: Corridor side of partitions, and as indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (406.4 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.04 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at showers, floor sinks, wet areas in kitchen and where indicated.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.05 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. LC-Bead: Use at exposed panel edges.
 3. L-Bead: Use where indicated.
 4. U-Bead: Use at exposed panel edges where indicated.
- C. Aluminum Trim: Install in locations indicated on Drawings.

3.06 SOUND CONTROL CEILING INSTALLATION

- A. Install panels to suspension system with joints staggered and with 3/8" gap at perimeter.
- B. Finish Level: Level 2, where concealed by suspended ceiling below.
- C. Finish Level: Level 5, where panels are exposed to view as finished ceiling.
- D. Seal the perimeter joint with acoustical sealant.
- E. When an acoustical tile ceiling is to be used below the sound barrier ceiling, continue the hanger wires to the acoustical ceiling and caulk all hanger wire penetrations where they pass through the gypsum ceiling.
- F. Where mechanical equipment, pipes or ducts fall below the barrier ceiling, provide additional hangers that are not connected to the barrier ceiling for this equipment and sponge sleeves

where penetrations pass through the barrier ceiling. Seal the perimeter of penetrations and sleeves with acoustical sealant.

3.07 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile or applied finish panel surfaces.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 - 4. Level 5: At all horizontal panel surfaces and panel surfaces scheduled to receive gloss, semigloss, or dry-erase coatings.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.08 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

**SECTION 09 3013
– CERAMIC AND PORCELAIN TILING**

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. Ceramic and porcelain wall and floor tile.
 - 2. Thresholds.
 - 3. Waterproof membrane.
 - 4. Crack isolation membrane.
 - 5. Metal edge strips.
- B. Related Sections:
 - 1. Division 07 Section "Self-Adhering Sheet Waterproofing" for waterproofing under thickset mortar beds.
 - 2. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 3. Division 09 Section "Gypsum Board" for cementitious backer units.

1.03 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification:
 - 1. Full size tile for each specified product
 - 2. Samples of specified grout color samples.
 - 3. Cut Sheets of each type and composition of tile and for each color and finish required.
 - 4. Cut sheets of each type of trim and accessory.
 - 5. Metal edge/transitio strips in 6-inch (150-mm) lengths.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Material Test Reports: For each tile-setting and -grouting product.

1.06 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.07 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
 1. Waterproof membrane.
 2. Crack isolation membrane.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 PRODUCTS

2.01 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.02 TILE PRODUCTS

- A. Tile Type TL-1: Porcelain Floor Tile, rectangular. See BASIS-OF-DESIGN PRODUCTS schedule on Sheet A700
 1. Grout Color: As specified on drawings

- B. Tile Type TL-2: Porcelain Floor Accent Tile, rectangular. See BASIS-OF-DESIGN PRODUCTS schedule on Sheet A700
 - 1. Grout Color: As specified on drawings.
- C. Tile Type TL-3: Porcelain Floor Tile, rectangular. See BASIS-OF-DESIGN PRODUCTS schedule on Sheet A700
 - 1. Grout Color: As specified on drawings
- D. Tile Type TL-4: Porcelain wall Tile, rectangular. See BASIS-OF-DESIGN PRODUCTS schedule on Sheet A700
 - 1. Grout Color: As specified on drawings
- E. Tile Type TL-5: Ceramic Wall Tile, rectangular. See BASIS-OF-DESIGN PRODUCTS schedule on Sheet A700
 - 1. Grout Color: As specified on drawings
- F. Tile Type TL-6: Porcelain Wall Accent Tile, rectangular. See BASIS-OF-DESIGN PRODUCTS schedule on Sheet A700
 - 1. Grout Color: As specified on drawings
- G. Tile Type TL-7: Ceramic Wall Accent Tile, rectangular. See BASIS-OF-DESIGN PRODUCTS schedule on Sheet A700
 - 1. Grout Color: As specified on drawings
- H. Tile Type TL-8: Porcelain Wall Accent Tile, rectangular. See BASIS-OF-DESIGN PRODUCTS schedule on Sheet A700
 - 1. Grout Color: As specified on drawings
- I. Tile Type TL-9: Porcelain Floor Tile, square. See BASIS-OF-DESIGN PRODUCTS schedule on Sheet A700
 - 1. Grout Color: As specified on drawings

2.03 THRESHOLDS AND TRANSITIONS

- A. General: Provide thresholds and transitions as indicated on finish legend sheet A700 as well as interior finish plan and interior elevations.

2.04 SETTING MATERIALS

- A. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch (15.88 mm).
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ARDEX Engineered Cements: www.ardexamericas.com
 - b. Bostik Inc: www.bostik-us.com
 - c. Custom Building Products: www.custombuildingproducts.com
 - d. Laticrete International: www.laticrete.com
 - 2. Provide prepackaged, dry-mortar mix containing dry, re-dispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

2.05 GROUT MATERIALS

- A. Epoxy Grout: ANSI A118.3 chemical resistant and water cleanable epoxy grout.
 - 1. Color(s); As indicated on drawings
 - 2. Products:
 - a. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout: www.custombuildingproducts.com

2.06 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section

"Joint Sealants."

1. Sealants shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

2.07 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- D. Tile Sealer: Provide clear protective tile sealer. Coordinate exact product with client prior to purchase/installation.
- E. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.08 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

2.09 TRANSITION EDGE PRODUCTS

- A. Transition Edge: Mill-finished extruded aluminum with vertical leg to protect the edge of the tile and anchoring leg with perforations for anchorage into setting materials.
1. Basis of Design: Schluter (refer to Drawings for model and profile)
 2. Finish: Brushed Stainless Steel

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with bonded mortar bed comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch (6.35 mm) per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.03 TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 1. Paver Tile: 1/8 inch (3.18 mm).

2. Glazed Wall Tile: 3/16 inch (4.76 mm).
- F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- G. Thresholds: Install thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
 2. Do not extend crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.
- H. Grout Sealer: Verify if grout sealer is required with grout manufacturer. Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.04 TILE BACKING PANEL INSTALLATION

- A. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.05 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove epoxy grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.06 ATTIC STOCK

- A. Provide 3% attic stock for all tile and trim units per UNT Design and Construction Standards

END OF SECTION

**SECTION 09 5113
ACOUSTICAL PANEL CEILINGS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.04 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension system members.
 - 2. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 4. Minimum Drawing Scale: 1/8 inch (3.18 mm) = 1 foot (30.48 cm).
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
- D. Qualification Data: For testing agency.
- E. Field quality-control test reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- G. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.
- H. Maintenance Data: For finishes to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated.

NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

- B. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 - 2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. Smoke-Developed Index: 450 or less.
- E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.09 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, 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. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 PRODUCTS

2.01 ACOUSTICAL PANELS, GENERAL

- A. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 1/2 percent by weight.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical

ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
- E. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.02 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING CL-2, CL-2M

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings:
1. For Typical Ceiling Areas CL-2: Armstrong World Industries, Inc., Calla, #2882 Square Lay in white, 24" x 24", NRC .95.
 2. For food Prep Areas CL-3: Armstrong World Industries, Inc., Kitchen Zone #683, Square Lay in white, 24" x 24", CAC 33
- B. Acoustical Field Panels:
1. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. High-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
 - b. Pattern: As indicated by manufacturer's designation.
 2. Color: White.
 3. LR: Not less than 0.85.
 4. NRC: Not less than 0.85.
 5. CAC: Not less than 35
 6. AC: Not less than 170.
 7. Edge/Joint Detail: Square lay in with Prelude XL 15/16" Exposed Tee.
 8. Thickness: 1-inch
 9. Suspension System: Prelude XL 15/16", color white.

2.03 CEMENTITIOUS WOOD FIBER ACOUSTICAL CEILING SYSTEM CL-3

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings:
1. For Accent Cloud Ceiling Areas CL-3: Armstrong World Industries, Inc., Tectum DesignArt - Bands Tegular Ceiling Panels.
 2. Color: Feldspar
 3. Size: Standard 24" x 24".
 4. Edge Profile: Tegular.
 5. Suspension System: Prelude XL 15/16", color white.
 6. Provide Axiom Trim to match color Feldspar

2.04 ACOUSTICAL SUSPENDED WOOD CEILING CL-4

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings:
 - 1. Armstrong World Industries, Inc. Woodworks Grille Forte Solid Ceiling Panel.
- B. Acoustical Field Panels:
 - 1. Color: Natural Walnut
 - 2. Size: Standard 12" x 96" panels, 3/4" thick x 1-3/8" high slats, with 4 slats per panel.
 - 3. Provide acoustic backer panel 1318
 - 4. Fire Rating: Fire Rating: ASTM E84 Class A
 - 5. NRC: Not less than 0.80.
 - 6. Acoustical Backing: Black Acoustical Infill Panel
 - 7. Edge/Joint Detail: Miter at corners.
 - 8. Suspension System: Prelude XL 15/16"
 - 9. Provide Axiom Trim: Coordinate color with Architect

2.05 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of pre consumer recycled content is not less than 25 percent.
- B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide finish as specified.
 - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Post installed expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0 inch (0 mm)) for Class SC 1 service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
- F. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- G. Angle Hangers: Angles with legs not less than 7/8 inch (22.22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- H. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (609.6 mm) on center on all cross tees.
- I. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.06 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Steel cold-rolled sheet.
 - 5. Cap Finish: As specified.

2.07 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, as that used for exposed flanges of suspension system runners. Color as indicated in drawings and specs.
 - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 - 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

2.08 ACOUSTICAL SEALANT

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - 2. Acoustical Sealant for Concealed Joints:
 - a. Pecora Corporation; BA-98.
- B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard non sag, paintable, non staining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements

for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 9. Do not attach hangers to steel deck tabs.
 10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 11. Space hangers not more than 48 inches (1219.2 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (203.2 mm) from ends of each member.
 12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (406.4 mm) o.c. and not more than 3 inches (76.2 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch (3.18 mm) in 12 feet (365.76 cm). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Product that is only available in a 24 by 48 inch (1219.2 mm) format will need to be cut to a 24 by 24 inch (609.6 mm) size.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
 7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.04 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections and prepare reports:
1. Suspended ceiling system.
 2. Hangers, anchors and fasteners.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and post installed anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every 2 post installed anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

- D. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

3.05 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

**SECTION 09 6513
RESILIENT BASE AND ACCESSORIES**

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. Resilient base.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Product Schedule: For resilient products. Use same designations indicated on drawings.

1.04 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.07 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F , in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F .
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 PRODUCTS

2.01 RESILIENT BASE RB-1

- A. Manufacturers:
 - 1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nora
 - b. Johnsonite.
 - c. Roppe Corporation, USA.
 - d. Mannington.

- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
- C. Product: Basis of Design Nora Noraplan ART 820 RB-1
- D. Minimum Thickness: 0.125 inch (3.18 mm).
- E. Height:
 - 1. 4 inches (101.6 mm) typ.
- F. Lengths: Coils in manufacturer's standard length.
- G. Outside Corners: Job formed or preformed.
- H. Inside Corners: Job formed or preformed.
- I. Finish: As specified on drawings.
- J. Colors and Patterns: As specified on drawings.

2.02 INSTALLATION MATERIALS

- A. Trowel-able Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - a. Cove Base Adhesives: Not more than 50 g/L.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowel-able leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Inside Corners: Use straight pieces of maximum lengths possible.

3.04 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION

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**SECTION 09 6519
RESILIENT TILE FLOORING**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Vinyl composition floor tile.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and pattern specified.

1.03 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.02 VINYL COMPOSITION FLOOR TILE ???INSERT DRAWING DESIGNATION???

- A. Basis-of-Design: Armstrong Flooring Standard Excelon Imperial Texture
- B. Tile Standard: ASTM F1066, Class 1.
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch (3.18 mm).
- E. Size: 12 by 12 inches (305 by 305 mm).
- F. Colors and Patterns: Refer to Finish Schedule .

2.03 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.02 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply two coat(s).

END OF SECTION

**SECTION 09 6723
RESINOUS FLOORING**

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. Resinous flooring.
 - 2. Integral cove base accessories.
- B. Related Sections:
 - 1. Section 071800 "Traffic Coatings" for vehicular-traffic-bearing, elastomeric flooring systems.
 - 2. Section 096623 "Resinous Matrix Terrazzo Flooring" for thinset, epoxy-matrix terrazzo.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation.
 - 2. Review details of integral cove bases.
 - 3. Review manufacturer's written instructions for installing resinous flooring systems.
 - 4. Review protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.
- B. Sustainable Design Submittals:
 - 1. Double click to insert sustainable design text for EPDs and HPDs.
 - 2. Double click here to insert sustainable design text for multi-attribute optimization.
 - 3. Double click to insert sustainable design text for recycled content.
 - 4. Double click here to insert sustainable design text for sourcing of raw materials.
 - 5. Double click here to insert sustainable design text for supply chain optimization.
 - 6. Double click to insert sustainable design text for flooring.
 - 7. Double click to insert sustainable design text for low-emitting floor finish system.
 - 8. Double click to insert sustainable design text for adhesives.
- C. Samples: For each resinous floor system required and for each color and texture specified, 6 inches (150 mm) square in size, applied to a rigid backing by Installer for this Project.
- D. Samples for Initial Selection: For each type of exposed finish required.
- E. Samples for Verification: For each resinous flooring system required and for each color and texture specified, 6 inches (152.4 mm) square, applied to a rigid backing by Installer for this Project.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each resinous flooring component.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.
- D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
 - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Apply full-thickness mockups on 96-inch- (2400-mm-) square floor area indicated on Drawings.
 - a. Include 96-inch (2400-mm) length of integral cove base with inside and outside corner.
 - 2. Simulate finished lighting conditions for Architect's review of mockups.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.09 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.
- C. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Double click to insert sustainable design text for flooring.
- B. Flammability: Self-extinguishing in accordance with ASTM D635.

2.02 RESINOUS FLOORING ???INSERT DRAWING DESIGNATION???

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
 - 1. Double click here to find, evaluate, and insert list of manufacturers and products.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.
- C. System Characteristics:
 - 1. Color and Pattern: As selected by Architect from manufacturer's full range ???Insert description???
 - 2. Wearing Surface: Textured for slip resistance ???Insert description???

3. Overall System Thickness: 20 mils (0.02 inch (0.5 mm)) ???Insert thickness???.
- D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested in accordance with test methods indicated:
 1. Compressive Strength: ???Insert value??? minimum in accordance with ASTM C579.
 2. Tensile Strength: ???Insert value??? minimum in accordance with ASTM C307.
 3. Flexural Modulus of Elasticity: ???Insert value??? minimum in accordance with ASTM C580.
 4. Water Absorption: ???Insert number??? percent maximum in accordance with ASTM C413.
 5. Shrinkage: ???Insert number??? percent maximum in accordance with ASTM C531.
 6. Indentation: ???Insert number??? percent maximum in accordance with MIL-D-3134J.
 7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation in accordance with MIL-D-3134J.
 8. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.59 mm) in accordance with MIL-D-3134J.
 9. Abrasion Resistance: ???Insert value??? maximum weight loss in accordance with ASTM D4060.
 10. Hardness: ???Insert value???, Shore D in accordance with ASTM D2240.
 11. Critical Radiant Flux: 0.45 W/sq. cm or greater in accordance with NFPA 253.
- E. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested in accordance with ASTM D1308 for 50 percent immersion ???Insert testing requirements??? in the following reagents for no fewer than seven days:
 1. ???Insert list of reagents that Owner has determined are likely to contact resinous flooring during in-service use???.
- F. Primer: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated.
 1. Products:
 - a. ???Insert, in separate subparagraphs, manufacturer's name; product name or designation???.
 2. Formulation Description: 100 percent solids ???Insert requirements???.
- G. Waterproofing Membrane: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated.
 1. Products:
 - a. ???Insert, in separate subparagraphs, manufacturer's name; product name or designation???.
 2. Formulation Description: 100 percent solids ???Insert requirements???.
- H. Reinforcing Membrane: Flexible resin formulation that is recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks from reflecting through resinous flooring.
 1. Products:
 - a. ???Insert, in separate subparagraphs, manufacturer's name; product name or designation???.
 2. Formulation Description: 100 percent solids ???Insert requirements???.
 - a. Provide fiberglass scrim embedded in reinforcing membrane.
- I. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended in writing by manufacturer for installation indicated.
 1. Products:
 - a. ???Insert, in separate subparagraphs, manufacturer's name; product name or designation???.
- J. Body Coats:
 1. Products:

- a. ???Insert, in separate subparagraphs, manufacturer's name; product name or designation???.
 2. Resin: Epoxy ???Insert resin???.
 3. Formulation Description: 100 percent solids ???Insert requirements???.
 4. Type: Clear ???Insert description???.
 5. Installation Method: Self-leveling slurry with broadcast aggregates.
 6. Number of Coats: One ???Insert number???.
 7. Thickness of Coats: 8 mils (0.01 inch (0.2 mm)) ???Insert thickness???.
 8. Aggregates: Manufacturer's standard ???Insert requirements???.
- K. Grout Coat:
1. Products:
 - a. ???Insert, in separate subparagraphs, manufacturer's name; product name or designation???.
 2. Resin: Epoxy ???Insert resin???.
 3. Formulation Description: 100 percent solids ???Insert requirements???.
 4. Type: Clear ???Insert description???.
 5. Thickness of Coat: 8 mils (0.01 inch (0.2 mm)) ???Insert thickness???.
- L. Topcoats: Sealing or finish coats.
1. Products:
 - a. ???Insert, in separate subparagraphs, manufacturer's name; product name or designation???.
 2. Resin: Epoxy ???Insert resin???.
 3. Formulation Description: 100 percent solids ???Insert requirements???.
 4. Type: Clear ???Insert description???.
 5. Number of Coats: One ???Insert number???.
 6. Thickness of Coats: 8 mils (0.01 inch (0.2 mm)) ???Insert thickness???.
 7. Finish: Matte.

2.03 INTEGRAL COVE BASE ACCESSORIES

- A. Precast, Integral Cove Base: Impact-resistant, polymer-resin, cove base moldings with a grit profile to promote adhesion of resinous flooring and recommended in writing by resinous flooring manufacturer.
1. Double click here to find, evaluate, and insert list of manufacturers and products.
 2. Radius Cove: Cove molding with approximately 1-inch (25-mm) radius for adhesive installation at floor-to-wall joint as substrate to receive resinous flooring system to form an integral cove base.
 3. Radius Cove Base: 4-inch- (102-mm-) high base molding that provides approximately 1-inch (25-mm) radius cove at floor-to-wall joint; for adhesive installation as substrate for resinous flooring system to form an integral cove base.
 - a. Prefomed Inside and Outside Corners: Provide manufacturer's standard square inside and square outside corners.
- B. Installation Adhesive: As recommended in writing by accessory manufacturer.
1. Double click to insert sustainable design text for laminating adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resinous flooring systems.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions for substrate indicated to ensure adhesion.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with requirements in SSPC-SP 13/NACE No. 6, with a Concrete Surface Profile of 3 or greater in accordance with ICRI Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.
 - 3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) ???Insert area???, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) ???Insert value??? in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 ???Insert number??? percent relative humidity level measurement.
 - 4. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 ???Insert number??? or more than 8 ???Insert number??? pH unless otherwise recommended in writing by flooring manufacturer,
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.
 - 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

3.03 INSTALLATION

- A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.
 - 1. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - 2. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.
 - 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at spreading rate recommended in writing by manufacturer.
- C. Waterproofing Membrane: Apply waterproofing membrane where indicated on Drawings ???Insert location???, in thickness recommended in writing by manufacturer.
 - 1. Apply waterproofing membrane to integral cove base substrates.
- D. Reinforcing Membrane: Apply reinforcing membrane to substrate cracks ???Insert requirements???

- E. Integral Cove Base Accessories: Adhesively install precast accessories before applying flooring coats and in accordance with manufacturer's written instructions.
- F. Field-Formed Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring coats. Apply in accordance with manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
 - 1. Integral Cove Base: 4 inches (101.6 mm) ???Insert dimension??? high.
- G. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness specified for flooring system.
 - 1. Aggregates: Broadcast aggregates at rate recommended in writing by manufacturer. After resin is cured, remove excess aggregates to provide surface texture indicated.
- H. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness specified for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended in writing by manufacturer.
- I. Grout Coat: Apply grout coat to fill voids in surface of final body coat.
- J. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

3.04 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may, at any time and any number of times during resinous flooring installation, require material samples for testing for compliance with requirements.
 - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reinstall flooring materials to comply with requirements.
- B. Core Sampling: At Owner's direction and at locations designated by Owner, take one core sample per 1000 sq. ft. (92.9 sq. m) of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

3.05 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION

**SECTION 09 6813
TILE CARPETING**

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 modular, tufted carpet tile.
- B. Related Requirements:
 - 1. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.
 - d. Adhesive pad installation requirements.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
- B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full sized sample of each tile specified. If pattern varies per tile provide 3 full samples for review
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- C. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).
 - 2. Adhesive Pad Connectors: One (1) full roll.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, excess static discharge, loss of face fiber, and delamination.
 - 3. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 CARPET TILE

- A. Products:
 - 1. Carpet Tile CP-1: Walk off carpet product TBD
 - a. Size: TBD
 - 2. See BASIS OF DESIGN PRODUCTS schedule on Sheet A700

2.02 INSTALLATION ACCESSORIES

- A. Trowel able Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
 - 1. Basis of Design: Schluter (refer to drawings and finish legend for model and profile)
 - 2. Finish: Brushed Stainless Steel

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. For raised access flooring systems, verify the following:
1. Access floor complies with installation requirements specified in Division 09 Section "Access Flooring."
 2. Access floor substrate is compatible with carpet tile and adhesive pad connectors.
 3. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than 1/8 inch (3.18 mm), protrusions more than 1/32 inch (0.79 mm), and substances that may interfere with adhesive bond or show through surface.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowel able leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3.18 mm) wide or wider and protrusions more than 1/32 inch (0.79 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.03 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Adhesive Pads; glue free adhesive connectors.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, non-staining marking device.
- G. Install pattern as indicated on drawings and finish legend.

3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
1. Remove yarns that protrude from carpet tile surface.
 2. Vacuum carpet tile using commercial machine with face-beater element.

- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

**SECTION 09 9123
INTERIOR PAINTING**

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 surface preparation and the application of paint systems on interior substrates. the following interior substrates:
 - 1. Concrete surfaces
 - 2. Gypsum board walls and ceilings.
 - 3. Hollow metal doors and frames.
 - 4. Miscellaneous incidental steel substrates.
- B. Related Requirements:
 - 1. Division 03 Section "Cast-In-Place Concrete" for hardeners and densifiers applied to concrete floors.
 - 2. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
 - 3. Division 06 Sections for shop priming carpentry with primers specified in this Section.
 - 4. Division 09 Sections for high-performance and special-use coatings.
 - 5. Division 09 Section "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.03 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit draw downs on rigid backing, 8 inches (203.2 mm) square.
 - 2. Label each Sample for location and application area.
- C. 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. VOC content.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 2 gal. unopened of each material and color applied.

1.06 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 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 (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.08 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Sherwin-Williams Company (The)
 2. PPG Architectural Finishes, Inc./Glidden
 3. Benjamin Moore & Co.

2.02 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 1. Provide materials for use within each paint 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. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 150 g/L.

3. Dry-Fog Coatings: 400 g/L.
 4. Primers, Sealers, and Undercoaters: 200 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Floor Coatings: 100 g/L.
 9. Shellacs, Clear: 730 g/L.
 10. Shellacs, Pigmented: 550 g/L.
 11. Dry Erase Coatings: 250 g/L.
- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 PRIMERS/SEALERS

- A. Primer Sealer, Interior, Institutional Low Odor/VOC:
1. Sherwin Williams; ProGreen 200 Interior Latex Primer
 2. Benjamin Moore; Eco Spec – Interior Latex Primer Sealer
 3. PPG; SpeedHide 6-2
- B. Primer, for Interior Concrete Substrates:
1. Sherwin Williams; Loxon
 2. Benjamin Moore; Eco Spec Primer Sealer
 3. PPG; Perma-Crete Alkali Resistant Primer 4-603

2.04 METAL PRIMERS

- A. Primer, Rust-Inhibitive, Water Based:
1. Sherwin Williams; Pro Industrial – ProCryl Universal Primer
 2. Benjamin Moore; Super Spec High Performance – Acrylic Metal Primer
 3. PPG; Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912

2.05 WATER-BASED PAINTS – ALL PAINT TYPES/FORMULAS SHOULD BE APPROVED BY THE CLIENT PRIOR TO PURCHASE.

- A. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1):
1. Sherwin Williams; SuperPaint Air Purifying- Interior Latex Flat
 2. Benjamin Moore; Eco Spec – Flat Interior Latex Enamel
 3. PPG; Speedhide 6-70 – Interior Latex Flat
- B. Latex, Interior, Institutional Low Odor/VOC, Eggshell (Gloss Level 2):
1. Sherwin Williams; SuperPaint Air Purifying – Interior Latex Egg-Shell
 2. Benjamin Moore; Eco Spec – Eggshell Interior Latex Enamel
 3. PPG; Speedhide 6-411 – Interior Latex Egg-Shell
- C. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5):
1. Sherwin Williams; by SuperPaint Air Purifying Semigloss
 2. Benjamin Moore; Eco Spec – Interior Latex Semi-Gloss Enamel
 3. PPG; Pure Performance 9-500 – Interior Latex Semi-Gloss
- D. Polyurethane, Water based, Low VOC, Semi-Gloss (Gloss Level 5)
1. Scuffmaster ScrubTough Max – For painted millwork
- E. Acrylic, Interior Dryfall (Flat)
1. Sherwin Williams Pro Industrial Waterborne Acrylic Dryfall

2.06 OIL-BASED PAINTS

- A. Alkyd, Interior, Semi-Gloss:
1. Sherwin Williams; ProMar 200.
 2. Benjamin Moore; Dulamel C207.

3. PPG; Speedhide 6-90 Series (Lo Sheen)

2.07 FLOOR COATINGS

- A. Sealer, Water Based, for Concrete Floors:
 1. Scofield: Cureseal-W
 2. Sherwin Williams: Concrete & Masonry Waterproofing Sealer.
 3. PPG: Plex Seal Int./Ext. Clear Sealer.
 4. Benjamin Moore: Approved equal.

2.08 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint 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 coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
 2. Wood: 15 percent.
 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI 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 if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

- E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
- F. 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.

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards if indicated on drawings
 - b. Uninsulated metal piping if indicated on drawings
 - c. Uninsulated plastic piping if indicated on drawings
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.04 FIELD QUALITY CONTROL

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

3.05 CLEANING AND PROTECTION

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

3.06 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Non-traffic Surfaces:
 - 1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Concrete primer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (eggshell).
- B. Concrete Substrates, Traffic Surfaces:
 - 1. Water-Based Clear Sealer System:
 - a. First Coat: Sealer, water based, for concrete floors.
 - b. Topcoat: Sealer, water based, for concrete floors.
- C. CMU Substrates:
 - 1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
- D. Steel Substrates, Hollow Metal Doors and Frames:
 - 1. Institutional Alkyd-Based Semi-Gloss Enamel System:
 - a. Prime Coat: Rust-inhibitive primer (for non-primed surfaces).
 - b. Intermediate Coat: Alkyd-based enamel matching topcoat.
 - c. Topcoat: Alkyd-based enamel (semigloss).
- E. Gypsum Board Substrates – Ceilings and Soffits:
 - 1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (flat).
- F. Gypsum Board Substrates - Walls:
 - 1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (finish as indicated on drawings).

END OF SECTION

**SECTION 10 1419
DIMENSIONAL LETTER SIGNAGE**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Dimensional characters.
 - a. Cast dimensional characters.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, tpestyles, graphic elements, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available tpestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Dimensional Characters: Full-size Sample of each type of dimensional character.
 - 2. Exposed Accessories: Full-size Sample of each accessory type.
 - 3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.
- E. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.06 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.07 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 DIMENSIONAL CHARACTERS

- A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
 - 1. Character Material: Cast aluminum.
 - 2. Character Height: As indicated on Drawings.
 - 3. Thickness: As indicated on Drawings.
 - 4. Finishes:
 - a. Integral Aluminum Finish: Clear anodized.
 - 5. Mounting: Concealed studs.
 - 6. Typeface: As indicted on drawings.

2.02 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

2.03 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish nonferrous-metal ???Insert requirement??? devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2.04 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 2. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.05 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.06 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0 inch (0.02 mm) or thicker.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF DIMENSIONAL CHARACTERS

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

3.03 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

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**SECTION 10 2113.19
PLASTIC TOILET COMPARTMENTS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

1.02 SUMMARY

- A. Section Includes:
1. Solid-plastic toilet compartments.
- B. Related Requirements:
1. Section 061000 "Rough Carpentry" for blocking and overhead support of post-to-ceiling screens.
 2. Section 092216 "Non-Structural Metal Framing" for blocking.
 3. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.03 COORDINATION

- A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

1.04 ACTION SUBMITTALS

- A. Product Data:
1. Solid-plastic toilet compartments:
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings:
1. Include plans, elevations, sections, details, and attachment details.
 2. Show locations of cutouts for compartment-mounted toilet accessories.
 3. Show locations of centerlines of toilet fixtures.
 4. Show locations of floor drains.
 5. Show ceiling-mounted items and overhead support or bracing locations.
- C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.
1. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.
1. Size: Manufacturer's standard size.
- E. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For toilet compartments.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Door Hinges: One hinge with associated fasteners.
 2. Latch and Keeper: One latch and keeper with associated fasteners.
 3. Door Bumper: One bumper with associated fasteners.

4. Door Pull: One door pull with associated fasteners.
5. Fasteners: 10 fasteners of each size and type.

1.07 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

PART 2 PRODUCTS

2.01 SOURCE LIMITATIONS

- A. Obtain plastic toilet compartments from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.
- B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:
 1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf (1112 N) applied at any direction and at any point, without deformation of panel.
- C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and the 2012 Texas Accessibility Standards for toilet compartments designated as accessible.

2.03 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Solid-Plastic (HDPE) Partitions or comparable product by one of the following:
 1. ASI Global Partitions
 2. AJW Architectural Products.
 3. Ampco by AJW.
 4. Marlite.
 5. PSISC.
 6. Weis-Robart Partitions, Inc.
- B. Toilet-Enclosure Style: Floor anchored / Overhead Braced.
- C. Entrance-Screen Style: Floor anchored / Overhead Braced.
- D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) material, not less than 1 inch (25.4 mm) thick, seamless, with eased edges, and with homogenous color throughout thickness of material. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).
 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
 2. Heat-Sink Strip: Manufacturer's continuous, stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
 3. Color: One color in each room as selected by Architect from manufacturer's full range.
- E. Entrance-Screen Construction: Matching panel construction.
- F. Urinal-Screen Construction: Matching panel construction.
- G. Pilaster Shoes: Manufacturer's standard design; stainless steel.
- H. Pilaster Sleeves (Caps): Manufacturer's standard design; stainless steel.
- I. Brackets (Fittings):
 1. Stirrup Type: Ear or U-brackets, stainless steel.
 2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.04 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories.

1. Hinges:
 - a. Manufacturer's paired, wraparound, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.
 - 1) Material, Paired Hinge: Aluminum.
2. Latch and Keeper: Manufacturer's surface-mounted latch unit, designed for emergency access, and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.
 - a. Material: Aluminum.
3. Coat Hook: Manufacturer's combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
 - a. Material: Manufacturer's standard.
4. Door Bumper: Manufacturer's rubber-tipped bumper at outswinging doors.
 - a. Material: Manufacturer's standard.
5. Door Pull: Manufacturer's unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
 - a. Material: Manufacturer's standard.

2.05 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: ASTM B221.
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.
- E. Zamac: ASTM B86, commercial zinc-alloy die castings.

2.06 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Ceiling-Hung Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- E. Floor-and-Ceiling-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- F. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies at posts and walls, with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.
- G. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard toilet enclosures and 36-inch-wide, outswinging doors with a minimum 32-inch-wide, clear opening for toilet enclosures designated as accessible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels or Screens: 1/2 inch (12.7 mm).
 - b. Panels or Screens and Walls: 1 inch (25.4 mm).
 - 2. Stirrup Brackets: Secure panels or screens to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel or screen.
 - a. Locate wall brackets, so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
 - 3. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (50.8 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust, so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust, so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
- E. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust, so doors are level and aligned with panels, when doors are in closed position.
- F. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.03 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION

**SECTION 10 2600
WALL PROTECTION**

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. Corner guards.

1.03 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
- B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.
 - 1. Include similar Samples of accent strips and accessories involving color selection.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of impact-resistant wall protection unit from single source from single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Division 01 Section "Quality Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M.

2.02 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards : Fabricated from one-piece, formed or extruded metal with formed edges; with 90-degree turn to match wall condition and to form lapped condition with adjacent material.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Inpro, www.inpro.com
 - b. Alpar Architectural Products, LLC.
 - c. Arden Architectural Specialties, Inc.
 - 2. Material: Stainless steel, Type 304.
 - a. Thickness: Minimum 16 gauge.

- b. Finish: Directional satin, No. 4.
 3. Wing Size: Nominal 1.5" by 1.5"
 4. Length: 48"
 5. Corner Radius: 1/8 inch (3.18 mm).
 6. Mounting: heavy duty adhesive recommended by manufacturer.
- B. Location: Provide corner guards on exposed corners of gypsum walls from top of wall base.

2.03 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

2.04 METAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Remove tool and die marks and stretch lines, or blend into finish.
 2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 3. Run grain of directional finishes with long dimension of each piece.
 4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.
- B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.03 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings or, if not indicated, at heights indicated below:
 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.

3.04 CLEANING

- A. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

**SECTION 10 2800
TOILET ACCESSORIES**

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. Public-use washroom accessories.
 - 2. Under-lavatory guards
 - 3. Custodial closet accessories.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.05 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 0.24 inch (6 mm) thick.

- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.02 UNIVERSITY SPECIFIC WASHROOM ACCESSORIES OFOI

- A. Toilet Tissue (Roll) Dispenser:
 - 1. By Owner
- B. Automatic Liquid-Soap Dispenser:
 - 1. By Owner
- C. Automatic Paper Towel (Roll) Dispenser:
 - 1. By Owner

2.03 OPEN MANUFACTURER WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, unless noted otherwise:
 - 1. A & J Washroom Accessories, Inc.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation.
 - 4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 - 5. Tubular Specialties Manufacturing, Inc.
- B. Sanitary-Napkin Disposal Unit:
 - 1. Basis-of-Design Product: Bobrick; Model B-270.
 - 2. Mounting: Surface mounted.
 - 3. Door or Cover: Self-closing, disposal-opening cover.
 - 4. Receptacle: Removable.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. Grab Bar:
 - 1. Mounting: Flanges with concealed fasteners.
 - 2. Material: Stainless steel, 0.05 inch (1.27 mm) thick.
 - 3. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 4. Outside Diameter: 1-1/2 inches (38 mm).
 - 5. Configuration and Length: As indicated on Drawings.
- D. Baby Changing Station:
 - 1. Bobrick KB300-SS Horizontal Surface-Mounted With Stainless Steel Veneer
 - 2. Mounting: Surface-Mounted
- E. Waste Receptacle:
 - 1. Bobrick ClassicSeries Recessed Waste Receptacle, Model Number B-3644.
 - 2. Mounting: Semi-recessed.
 - 3. Minimum Capacity: 12 gal.
 - 4. Material and Finish: Stainless steel, No. 4 finish (satin).

2.04 UNDER-LAVATORY GUARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Plumberex Specialty Products, Inc.
 - 2. Truebro by IPS Corporation.
- B. Under-lavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.

2.05 CUSTODIAL CLOSET ACCESSORIES

- A. Mop and Broom Holder:

1. Basis-of-Design Product: Bobrick; Model B-223
 2. Material and Finish: Type 304, 22-gauge stainless steel with satin finish.
 3. Mounting: Surface mounted.
 4. Configuration: 24" long with three (3) spring loaded rubber cam holders.
- B. Wall Shelving:
1. Basis-of-Design Product: Stainless Supply Stainless Steel Shelving, Model SSLF-304-1236.
 2. Material and Finish: Type 304 stainless steel, 18 gauge.
 3. Configuration: Provide four (4) 12" x 36" shelves with adjustable brackets and upright/slotted single uprights for each location.
 4. Mounting: Mount bottom shelf 24" above the finish floor and 16" between each shelf.
- C. Mirrors:
1. Basis-of-Design Products: Bobrick; B-1658 Series.
 2. Nominal Size: As indicated on Drawings.
 3. Location: Toilet rooms.

2.06 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.02 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

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**SECTION 10 4413
FIRE EXTINGUISHER CABINETS**

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. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Size: 6 by 6 inches (152.4 mm) square.

1.04 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209.
 - 2. Extruded Shapes: ASTM B 221.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 0.12 inch (3 mm) thick, Class 1 (clear).

2.02 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for 10A - BC fire extinguisher.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire End & Croker Corporation.
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group.
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
 - d. Larsen's Manufacturing Company.
 - e. Modern Metal Products, Division of Technico Inc..
 - f. Moon-American.
 - g. Potter Roemer LLC.
 - h. Watrous Division, American Specialties, Inc.
- B. Cabinet Construction:

1. Nonrated: Unless noted otherwise
 2. Rated: Provide in fire-rated walls as indicated on Drawings.
- C. Cabinet Material: Steel and Stainless-steel sheet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
1. Rolled-Edge Trim: 2-1/2 or 3-inch backbend depth.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
1. Provide recessed door pull and friction latch.
 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
- K. Finishes:
1. Manufacturer's standard baked-enamel paint for the following:
 - a. Interior of cabinet.
 2. Aluminum: Clear anodic.
 3. Steel: Baked enamel or powder coat.
 4. Stainless Steel: No. 4.

2.03 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (12.7 mm) thick.
 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.04 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.05 STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.0508 mm).

2.06 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire Protection Cabinets: 54 inches (1371.6 mm) above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.04 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 11 40 00
FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Documents, apply to the Work specified in this Section.

1.2 SUMMARY OF THE WORK

- A. Project Name and Location: UNT Kerr Hall Dining Renovation
Denton, TEXAS
- B. Approval of Working Surface: any contractor performing work over the work of other contractors shall notify the Architect of any unsatisfactory conditions. Beginning of work by any contractor shall constitute acceptance of the previous work.
- C. Checking Dimensions at Site: before ordering any materials or doing any work, verify all measurements of the building and be responsible for the accuracy of them. No extras will be allowed for variations from drawings in existing conditions or for work performed under this contract. Any discrepancies found shall be submitted to the Architect or Foodservice Consultant for instructions before proceeding.
- D. Cutting and Patching: No excessive cutting will be permitted, nor shall any structural members be cut without the written approval of the Architect. Each Contractor shall leave all chases and openings straight, true and of the proper size in his work as may be necessary for the proper installation of his and other contractors' work. After such work has been installed, he shall carefully fit around, close up, repair, patch and point up same as directed, to the entire satisfaction of the Architect.
- E. Cooperation: The General Contractor, all other contractors and all subcontractors shall coordinate their work with all adjacent work and shall cooperate with all other trades to facilitate the general progress of the work. Each trade shall afford all the other trades every reasonable opportunity for installation of their work and storage of their material.
- F. Inspection and Tests: Architect, Owner, Foodservice Consultant and their representative shall at all times have access to the work whether it is in preparation or progress. Provide proper and safe facilities for such access and inspection.
- G. Fees, Permits and Inspections: secure and pay fees for all permits, licenses and inspections as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, codes, rules, regulations and contract requirements bearing on the work.

1.3 SCOPE

- A. Include the Work specified, shown or reasonably inferable as part of Foodservice Equipment. Portions of this Work may be subcontracted to those qualified to do such work, as may be necessary because of jurisdictional trade agreements and restrictions.
- B. The General Contractor is responsible for Related Work specified in other Sections: i.e. final plumbing, electrical and mechanical connections. The Foodservice Equipment Contractor is responsible for all internal connections when specified.

- C. Specifications and drawings have been prepared to form the basis for procurement, erection, startup and adjustment of all equipment in this contract. Plans and specifications shall be considered as mutually explanatory and work required by one, but not by the other, shall be performed as though required by both. Items required by one, but not by the other shall be provided as though required by both. Work shall be accomplished as called for in specifications and shown on drawings, so that all items of equipment shall be completely functional for purpose for which they were designed. Provide all necessary material, tools, equipment and labor required for the complete installation. When there is any discrepancy between drawings and specifications, bidders should seek clarification of any discrepancies from the Architect/Consultant prior to bidding.
- D. Should the drawings disagree in themselves, or the specifications with the drawings, the better quality, more stringent, and/or greater quantity of the work or materials shall be completed without additional costs to the Owner.

1.4 OTHER DIVISIONS/CONTRACTORS RELATED WORK

A. Division 03 (Concrete) is responsible for but not limited to:

- 1. Slab depressions reinforced concrete wearing bed at prefabricated cold storage assemblies.
- 2. Concrete or masonry platforms (with a finished top and coved base at the perimeter) for the raised setting of food service equipment.
- 3. Slab depressions to receive stainless steel drain trench liner/grate assemblies (provided under this Section).

B. Division 09 (Finishes) responsible for but not limited to:

- 1. Interior finished floor with a coved base at prefabricated cold storage assemblies.

C. Division 10 (Specialties) responsible for but not limited to:

- 1. S/S Corner Guards throughout the kitchen (unless specified otherwise).
- 2. Lockers.

D. Division 22 (Plumbing) is responsible for but not limited to:

- 1. All connections shall follow local codes and national standards, except where plans and specifications exceed those codes and standards.
- 2. Empty PVC and wide-sweep bends for refrigerant piping to beverage lines, Co2 lines, and remote food service equipment refrigeration systems.
- 3. Rough-in and final connection of plumbing systems to food service equipment and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 22. This includes but is not limited to the installation of all faucets (water fill faucets, pre-rinse faucets, etc.), hoses, gas disconnects, and drains from the equipment point of connection to building plumbing systems.
 - a. Kitchen Equipment Contractor is responsible for providing all faucets (water fill faucets, pre-rinse faucets, etc.), drain fittings, mixing valves, control valves, water pressure regulators, vacuum breakers, and all accessories for equipment specified under 11 40 00. Division 22 is responsible for installation.
- 4. Indirect drain line runs from the equipment to the nearest drain or floor sink—lines to be type 'K' Copper.

5. If any plumbing accessories or fittings are provided loose with equipment by 11 40 00, Div. 22 is to attach to equipment and provide final connection.
6. Gas Supply Systems with all components and fittings required for a complete system.
7. Water Supply Systems with all components and fittings required for a complete system.
8. Compressed Air Systems with all components and fittings required for a complete system.
9. Piping and Drainage Systems (Sanitary and grease laden). Systems are to be cleaned before the final connection with food service equipment.
10. Floor Sinks (Provide and Install). Flange and grates to be flush with the finished floor.
11. Floor Drains (Provide and Install). Flange and grates to be flush with the finished floor.
12. Trench Drains (Provide and Install). Trench Liners provided by 11 40 00. Flange and liners to be flush with the finished floor.
13. Grease Traps as required (Size, Provide, Locate, and Install). Verify with local codes to bypass or pipe thru Grease Trap and/or Interceptor.
14. P-Traps as required (including all disposers).
15. Interconnect water thru Water Filter (Filter provided by 11 40 00 unless otherwise specified) to equipment.
16. Gas Quick Disconnect Installation (Quick Disconnect provided by 11 40 00).
17. Safety Restraint Cable Installation (Safety Restraint Cable Provided by 11 40 00).
18. Specified couplings and piping to all equipment furnished by 11 40 00.
19. Air Compressors (Size, Provide, and Install unless otherwise specified).
20. Water Softeners (Size, Provide, and Install unless otherwise specified).
21. Pressure Boilers (Size, Provide, and Install unless otherwise specified).
22. Hand Sinks (Provide (unless otherwise specified) and Install). Provide a hot water tempering valve if required. Water temperature to be at least 100 degrees and flow for at least 20 seconds.
23. Ice Bin Drain Insulation (Provide and Install).
24. Unions at disposer solenoid valves (Provide and Install).
25. Back Flow Prevention as required (Provide and Install - including all disposers). Back- Siphonage shall be installed at all fixtures and equipment where backflow and/or back-siphonage may occur and where a minimum air gap cannot be provided between the water to the fixture or equipment at its flood/level rim. When furnished with equipment, vacuum breakers shall override the above if acceptable with applicable codes. Division 22 is responsible for verifying requirements with local codes.
26. Janitor Sink with Faucet (Provide and Install).
27. Freeze Proof Hose Bibb at the exterior of the building by receiving door (Provide and Install - unless otherwise specified).
28. Reverse Osmosis Systems (Size, Provide (unless otherwise specified), Locate, and Install).
29. All piping within the counter body or under fabricated counters must be run to a connection point below the counter body by Section 11 40 00—final connection by Division 22.
30. Exhaust Hood condensate drain connections (Provide and Install).
31. Interconnection of ½" CW to Pre-Rinse and Disposers cone/body inlets piped through the solenoid and vacuum breaker.
32. Fire System Piping. The exposed piping is to be chrome plated.
33. Pipe ½" cold water to swirl inlets at disposers.
34. Water Treatment for Ice Builders (Non-Chlorinated water with a PH Level of 10 or Higher) and any drains and overflows. Piping from Ice Builders to Tumble Chillers by Div. 23.
35. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

E. Division 23 (Mechanical) responsible for but not limited to:

1. All connections shall follow local codes and national standards, except where plans and specifications exceed those codes and standards.
2. Empty EMT Conduit with pull-wire and wide-sweep bends for refrigerant piping to remote food service equipment refrigeration systems.
3. Rough-in and final connection of mechanical systems to food service equipment, cold storage assemblies, and between components (including materials and labor).
4. A mechanical contractor will test and balance rooms and exhaust hoods. **Balance report for food service Exhaust Hoods to be provided to Foodservice Design Professionals (FDP) immediately upon completion (send to Dallas.Submittal@fdp.org) and must be submitted with O&M manuals.**
5. Exhaust Hoods, Condensate Hoods, Fire Suppression Systems, connections, and controls (Provide and Install – unless otherwise specified). Provide tempered air at all supply ducts.
 - a. If Exhaust/Condensate Hoods and Fire Suppression Systems are specified under Section 11 40 00, Division 23 is responsible for all Exhaust and Condensate Hood connections (Provide and Install).
6. VFD System and controllers when required by code (Provide and Install).
7. Provide and install all ventilation (direct or indirect), air conditioning, and heating systems (unless otherwise specified).
8. Coordinate Supply and Return ducts above Serving Counters. Cold air is not to blow directly on hot food counters or open-air refrigerated merchandisers.
9. Coordinate Supply and Return ducts away from equipment with top-mounted refrigeration. Air is not to blow directly on compressors.
10. Mechanical Contractor to locate temperature monitors within return ducts.
11. Circulating air above cold storage assemblies (Provide and Install).
12. Circulating air above and in air gaps at Warehouse cold storage assemblies (Provide and Install).
13. Water Chillers as required (Provide, Size, and Locate).
14. Piping from Ice Builders to Tumble Chillers (Size, Provide and Install).
15. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

F. Division 26 (Electrical) responsible for but not limited to:

1. Rough-in and final connection of electrical systems to food service equipment, cold storage assemblies, and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 26.
2. Empty EMT Conduit with pull-wire and wide-sweep bends for refrigerant piping to remote food service equipment refrigeration systems.
3. Empty EMT Conduit with pull-wire and wide-sweep bends for interconnect cables between LAN and POS terminals, change-makers, pre-check units, printers, CPUs, etc. Division 26 to verify where the conduit will run for POS System (i.e., Manager's Office or IDF Room).
4. Empty EMT Conduit with pull-wire and wide-sweep bends for fire suppression systems. Interconnect the Fire Protection System to panel box shunt trips and building alarms.
5. Cold Storage Assembly Light Fixture Installation (Provided loose by Section 11 40 00).
6. Table Limit Switch Installation (Provided loose by Section 11 40 00).
7. Electrical Materials and Devices (Shunt-trip breakers, surge protectors, lighting control devices, conduit, wire, etc.).
8. Switches and Stainless Steel Disconnects as required (Provide, Locate, and Install – to be in an accessible location).

9. Charging Stations for Forklifts, Pallet Stackers, and Pallet Jacks (Size, Provide, Locate, and Install).
10. Interconnection between Condensate Fan and Dishmachine control panel.
11. Interconnection between Exhaust Hood fans and switch.
12. Interconnection between Exhaust Hood lights and switch.
13. Door Heaters, Lights, Coils, and Heated Pressure Relief Ports pre-wired to the junction box at the top of cold storage assemblies provided by Section 11 40 00— final connection by Div. 26.
14. If any electrical accessories, fittings, and cord/plugs are provided loose with equipment by 11 40 00, Div. 26 is to attach to equipment and provide final connection.
15. Provide waterproof receptacles in wet areas.
16. All electrical connections beneath Exhaust Hoods to extend to shunt trip breakers with electrical panel box for shutdown during fire mode.
17. Receptacles will be pre-wired to Junction Box or Load Center for final connection by Division 26.
18. All electrical lighting, power, and distribution systems.
19. Do not interconnect more than three (3) convenience outlets on one (1) breaker.
20. Other than convenience outlets, all electrical connections on food service plans are dedicated breakers.
21. Doorbell at receiving door (Provide and Install –audible throughout Kitchen, Office, and Dry Storage room).
22. Adequate lighting at receiving door.
23. Dedicated circuit for heated drain line connection in Walk-In Freezer (120/1/16.0 Amp) at each coil.
24. Provide and install (2) Edwards 860 Series (or equal) red lens, surface-mounted Xenon Emergency Strobe Beacons. One (1) to be located in the Kitchen above Walk-In Freezer door (or Cooler door when Freezer is within Cooler in an 'inline' assembly), and One (1) to be located in the Cafetorium (Coordinate location with Owners). Provide all conduit and wiring required, and interconnect the illuminated Push Button Panic Alarm in the Walk-In Freezer to both Strobe Beacons (Critical). Coordinate with Division 27.
25. Refer to Section 2.5, ELECTRICAL REQUIREMENTS, for additional information.

G. Division 27 (Communication) responsible for but not limited to:

1. Data line coordination for food service equipment.
2. Time clocks.
3. Video cameras for learning assistance in food service areas as required (Provide, Locate, and Install).
4. Provide conduit, data line, and interconnect the illuminated Push Button Panic Alarm inside the Walk-In Freezer to the Building Automation System (BAS). When activated, facility personnel are to be notified - coordinate notification requirements with the Owner (Critical). Coordinate with Division 26.

H. Division 28 (Electronic Safety and Security) is responsible for but not limited to:

1. Security Cameras as required (Provide, Locate, and Install).
2. Interconnection of Entrapment Panic Alarm for Cold Storage Assembly to the main Building Alarm System that will notify the person designated by the Owner that the Entrapment Panic Alarm has been activated (**Critical**).

I. General Contractor responsible for but not limited to:

1. Any wall penetration required for food service equipment utilities. Escutcheon plates or S/S sleeves are to be provided and installed as needed.

2. Bulk Freezer Ventilation Pipe (Provide and Install unless otherwise specified).
3. Core drilling for Guide Rails.
4. Refrigeration Roof Curbs / Roof Jack.
5. Interior Bollards – to be epoxy painted per local codes (Provide and Install).
6. Provide and Install ¾" Plywood blocking in the wall for mounting equipment furnished by Section 11 40 00 as required.
7. Cold Storage Assembly Depressions (to be dead level) and sand leveling bed.
8. Structural bracing for Bulk Cold Storage Assembly ceiling panels if required.
9. Menu System Video Monitors in Servery (unless otherwise specified).
10. Structural bracing for Menu System Video Monitors if required.
11. Interior/Exterior refrigeration penetrations and sleeves at building penetrations.
12. Door Scope viewer (peephole) with wide viewing angle at receiving door.
13. Canopy at receiving door. Coordinate height with the height of Receiving Door (8') and the mounting height of Air Screen above the door.
14. Soap and towel dispenser provided by Owner. G.C. is responsible for installation.
15. Washer and Dryer (Provide and Install, unless otherwise specified).
16. Dwarf wall at exposed front/ends of cafeteria serving counters with the finish as selected by the Architect.
17. Final cleaning of all equipment before demonstrations.

1.5 QUALITY ASSURANCE

- A. In addition to complying with all applicable laws, statutes, building codes and regulations of public authorities, comply with the following:
 1. National Sanitation Foundation (all equipment to bear label).
 2. National Electric Code.
 3. Underwriters' Laboratories, Inc. (all applicable equipment to bear label).
 4. CSA certified (all applicable equipment to bear label)
 5. American Gas Association Laboratories.
 6. National Fire Protection Association.
 7. Americans with Disabilities Act.
 8. Food and Drug Administration HACCP Guidelines.
 9. International Energy Conservation Code(IECC).
 10. Department of Energy.
 11. Environmental Protection Agency
- B. Furnish certification of regularly manufactured equipment listing or classification by Underwriter's Laboratories, Inc. with initial submittal.
- C. Furnish list of equipment and components (internal and external) that are not of domestic origin. All equipment and components (internal and external) should be of domestic origin when possible. This information should be provided with the initial submittal.
- D. Projects outside the continental United States shall adhere to all local authorities having jurisdiction over that project.

1.6 SUBSTITUTIONS

- A. Equipment items or components specified are intended to be the Basis of Bid. All other brands, including any additional names, which may be listed as "Alternates" or "Approved Equal," must conform with the specifications, size, accessories, function, etc. of the first-named brand and be subject to Paragraph C-03 of this Article.
- B. Proposed Substitutions:

1. Submitted no less than 14 calendar days prior to Bid Date.
2. Submit proposed substitutions with catalog data and/or manufacturer's shop details indicating all modifications required to conform with specified brand.
3. List of deviations must include listing of equipment name, model number, accessories and features with deviation(s) noted for both specified and proposed alternate equipment. Equipment without listed deviation(s) will be considered to be furnished as specified.

C. Substitutions with prior approval:

1. Submitted on Bidder's letterhead attached to Proposal Form with individual additive/deductive amounts stipulated and the documentation required in Paragraph B02.
 2. Owner reserves the right to accept or reject any or all substitution proposals before execution of Contract.
 3. Provide all design/engineering services required to make adjustments in space, systems, utilities, etc. and pay all additional costs of utilities, construction or professional services that may be incurred due to the acceptance of any substitution.
- D. All appliances within common group or category (e.g., refrigerators, kettles, ovens, etc.): same manufacturer.

1.7 INTERPRETATION OF DOCUMENTS

- A. During Bidding: contractor's, supplier's or vendor's questions and comments pertaining to Construction Document's clarity or intent will be addressed by addendum.
- B. Subsequent to Award:
1. Confirmation of Construction Document requirements will be provided by Clarification Bulletin.
 2. Request for Information Bulletins submitted by Contractor: contain Contractor's proposed resolution.

1.8 WARRANTY

- A. Provide a written warranty for a period of one year from the date of Substantial Completion, including extended four-year replacement warranty on compressor bodies.
- B. Components of equipment subject to replacement prior to one-year's use (such as refrigerator door gaskets) and those items which may fail due to improper or inadequate periodic maintenance by the Owner/Operator (such as an uncleaned refrigeration system condenser) are not intended to be included within the scope of the Warranty.
- C. Refrigeration Systems/Equipment: one-year free service available within twenty-four hours of notification.
- D. Furnish three copies of a list of all equipment and their respective local service agencies, indicating the address, telephone number and name of person to contact. Whenever possible, the service agencies selected shall be factory-authorized for the equipment assigned.
- E. Provide following for refrigeration systems/equipment, unless specified otherwise:
1. One (1) year free service available within twenty-four hours of notification, for refrigeration systems.

2. Provide five (5) year manufacturer's registered written replacement, warranty certificate, covering compressor bodies. Warranty to cover labor costs for first year.
 3. Provide ten (10) year manufacturer's registered written replacement/repair, warranty certificate, covering walk-in panels. Warranty to cover defects in material and workmanship. Warranty to cover labor costs for first year.
 4. Provide two (2) year parts and labor warranty for **all parts/components (including third-party components that may be utilized)** of the refrigeration system(s) **(including freon)**, cold storage cooler(s), and freezer(s) not otherwise covered herein.
- F. **All above-stated warranty periods are from the date of Substantial Completion.** All replacement parts due to a warranty call should be the same quality as the original, or better if the original were defective. Replacement parts should be of a domestic origin where possible.

1.9 SUBMITTAL DATA

- A. Special Requirements: the following are in addition to any general requirements given elsewhere in the Documents.
- B. Submittal Requirements:
1. Kitchen Equipment Contractor to furnish all submittals via PDF, drawings to be scaled per General Specifications and provided in Three (3) submittal packages.
 2. Foodservice Design Professionals requires the below listed business days for each package submitted. Packages to be submitted with 14 days between each issued package.
 - a. Package One: 10 Business Days
 - i. Equipment rough-in
 - ii. Equipment Brochure
 - b. Package Two: 10 Business Days
 - i. Exhaust Hood
 - ii. Cold Storage Assembly
 - iii. Refrigeration
 - c. Package Three: 15 Business Days
 - i. Custom Fabrication
 - ii. Serving Counter
 - iii. Merchandising Equipment
 - iv. Miscellaneous submittals
- C. Submittals to be identified with the below listed file name structure:
- i. 11 4000-1 EQUIPMENT BROCHURE
 - ii. 11 4000-2 EQUIPMENT ROUGH-IN PLANS
 - iii. 11 4000-3 CUSTOM FABRICATION
 - iv. 11 4000-4 SERVING COUNTER
 - v. 11 4000-5 EXHAUST HOODS
 - vi. 11 4000-6 COLD STORAGE ASSEMBLY
 - vii. 11 4000-7 REFRIGERATION
 - viii. 11 4000-8 BEVERAGE MERCHANDISER

- D. Package One (1) requires both submittals-Brochure and Rough-in plans. If not sent together, submittal will be rejected.
- E. All submittals will be notated in RED, architect, and general contractor to be colored per their direction.
- F. If hard copy submittals are required, kitchen contractor to furnish all hard copies as required to the specified trades.
- G. If discrepancies, missing information, or incorrect information occur within the documents, kitchen contractor to seek clarification or clearly notate on submittals the need for further direction. Kitchen contractor is to bid the higher of the discrepancy. Per General specifications (Section 1.3. Scope subparagraph D)..
- H. Brochure Format (for regularly-manufactured equipment and components):
 - 1. Front and rear protective cover with labeled project name.
 - 2. Brochure index: indicate functional Area/Room number, item number, quantity, description and manufacturer.
 - 3. A separate flysheet for each component or item of equipment, indicating: item number, name, quantity, manufacturer, optional equipment, modifications, special instructions and utility requirements. An item of equipment or assembly containing more than one buyout sub-assembly or component shall have the secondary item listed in parenthesis beside the primary item name. For example: Serving Counter (hot food well).
 - 4. Catalog specification sheet and manufacturer's drawing.
- I. Shop Drawings (Rough-In Drawings):
 - 1. Separate drawing sheets: same size as Contract Drawings (Contract Drawings are not to be traced or reproduced). Submittal drawings are to be provided by Kitchen Equipment Contractor and not reproduced from Contract Documents. Any reproduced submittal drawings will be rejected.
 - 2. 1/4" scale drawing of fixed/movable Foodservice Equipment and pre-fabricated Cold Storage Assemblies with itemized schedules.
 - 3. Special Conditions Drawings, sizing and locating the following conditions:
 - a. Slab depressions, cores, sleeves or block-outs (cold storage assemblies, drain trenches, piping, etc.).
 - b. Concrete or masonry platforms.
 - c. Pipe sleeves or roof jacks.
 - d. Wall-openings or block-outs for pass-through equipment, recessed control panels, in-wall fire-protection system components, etc.
 - e. Blocking grounds or anchor plates required in walls for equipment support/attachment.
 - f. Above-ceiling hanger assemblies for support of exhaust hoods, utensil-racks, etc.
 - g. Access panels in walls or ceiling for service of equipment.
 - h. Ceiling pockets or recesses for unusually high equipment.
 - i. In-wall carriers for wall-hung or cantilevered equipment.
 - 4. Electrical rough-in drawing.
 - 5. Plumbing/mechanical rough-in drawing.
 - 6. Required information:
 - a. All fixed and movable Foodservice Equipment shown on Contract Drawings.

- b. All prefabricated Cold Storage Assemblies and Conveyor/Dishtable Assemblies shown on Contract Drawings.
 - c. All general-use and convenience utilities or services indicated on Contract Drawings, including those required by or connected to equipment or devices not in this Section.
 - d. All rough-in drawings: fully dimensioned from engineering benchmark (column lines, when provided) and finished-room surface to point of stub-up through floor and stub-out through wall or ceiling for all mechanical, electrical and plumbing services.
 - e. Connection number/tag system and symbols: identical to Contract Drawings.
- J. Shop Drawings (Manufacturer's and Fabricator's):
- 1. Sheet Size: identical to Contract Drawings, drawn or plotted at $\frac{3}{4}$ " scale for plan view and elevations; $1\frac{1}{2}$ " scale for sections and construction details.
 - 2. Included information: item number, name and quantity.
 - 3. Construction details, sections and elevations to reflect requirements of the Specifications and Drawings.
 - 2. Indicate adjacent walls, columns and equipment.
 - 3. Indicate plumbing and electrical schematic drawings for equipment such as: conveyors, waste systems, self-cleaning exhaust hoods, exhaust hood fire protection systems and fabricated fixtures with single electrical or plumbing connection.
 - 4. Mechanical or electrical operating components or products integrated into a fabricated fixture: ventilation and service access required or recommended by the manufacturer, including panel size and location to permit easy lubrication, adjustment or replacement of all moving parts.
- K. All equipment and engineering rough-in plans sheet numbers are to match the contract documents. All equipment item no.'s and engineer item no.'s located on the schedules are to match the contract documents. All engineering requirements are to be updated as required to accommodate the provided equipment and/or match the contract documents. The Kitchen Contractor is responsible for the coordination of any MEP revisions to accommodate the provided and proposed equipment. The kitchen contractor is responsible for any costs associated with equipment substitution.
- L. FDP drawings and schedules are not to be copied in anyway. Any replicated drawings of FDP will be rejected.

1.10 SERVICE MANUAL

- A. Three copies bound in $1\frac{1}{2}$ " hardback, three-ring binders (as many volumes as required by scope of project) with same data as brochure at completion of installation (Refer to "Submittal Data"). Provide separate service manuals as required for each independent area within the project scope (Main Kitchen, Culinary, Concession, etc.).
- B. Each Volume: section for maintenance of finish materials (e.g., stainless steel, plastic laminates, FRP, Plexiglas, etc.).
- C. Catalog specification sheet and/or manufacturer's shop drawings.
- D. Each Volume: index of items, manufacturer's operating/maintenance information, replacement parts data and price lists. Provide the name, title and address of personnel at each respective manufacturer to be contacted for spare/replacement parts after warranty period.

- E. To the extent possible, provide two copies of manufacturer's video instructional cassettes for operating, maintenance and service of equipment.
- F. Internally subdivide binder contents with permanent page dividers, logically organized by equipment item number or manufacturer name, with tab titling clearly printed under reinforced laminated plastic tabs.
- G. Electronically submitted manuals are required to follow the same formatting requirements listed above.

1.11 VERIFICATION AND COORDINATION OF PROJECT / DATA

- A. Utilities Rough-in Drawings and Field-Services within four weeks after receipt of notice-to-proceed, review Contract Drawings and Submittal Data for accuracy and completeness and notify Architect of conflicts and proposed adjustments. Coordinate work with other sub-contractors.
 - a. KEC to provide on-site field verification of all underground utilities prior to pouring of concrete for capacity and location, coordinate with General Contractor. Submit review to Architect and General Contractor.
 - b. KEC to provide on-site field verification of all other utility connections and locations, coordinate with General Contractor. Submit review to Architect and General Contractor.
- B. ON-SITE INSPECTION REPORTS
 - a. Prior to concrete pour. (KEC to submit a copy of the report below to the Architect, General Contractor and Foodservice Consultant within 24 hours of the inspection.)
 - b. Prior to delivery of equipment. (KEC to submit a copy of the report below to the Architect, General Contractor, and Foodservice Consultant with-in 24 hours of the inspection.)



On - Site Inspection Report
Prior to Concrete Pour

Inspection Date _____ Project Name _____

Project Location _____

Inspector's Name _____ Company _____

Inspector's Contact Number _____ Email _____

Architectural Firm _____ Project Architect _____

Architect's Contact Number _____ Email _____

General Contractor _____ Project Manager _____

G.C. Contact Number _____ Email _____

Foodservice Consultant **FDP** Project Manager _____
Consultant Number - Dallas **972-245-5300**
Consultant Number - Houston **281-350-2323** Email _____

An on-site inspection to verify the location of underground utilities was conducted on this date. The following conditions were observed and brought to the attention of the General Contractor. (KEC is to provide a written description and copy of the Utility Plan indicating the corrective action required).

1. What difficulties were encountered?

Inspector's Initials _____

This Inspection Report is the responsibility of the Kitchen Equipment Supplier and the General Contractor. Coordination between the two parties is mandatory. Neither the Architect nor the Kitchen Consultant need to be present at any of the inspections.

EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE CONSULTANT.



**On - Site Inspection Report
Prior to Delivery of Equipment**

Inspection Date _____ Project Name _____

Project Location _____

Inspector's Name _____ Company _____

Inspector's Contact Number _____ Email _____

Architectural Firm _____ Project Architect _____

Architect's Contact Number _____ Email _____

General Contractor _____ Project Manager _____

G.C. Contact Number _____ Email _____

Foodservice Consultant **FDP** Project Manager _____

Consultant Number - Dallas **972-245-5300**

Consultant Number - Houston **281-350-2323**

Email _____

An on-site inspection to verify the location of installed utilities was conducted on this date. The following conditions were observed and brought to the attention of the General Contractor. (KEC is to provide a written description and copy of the Utility Plan indicating the corrective action required).

1. What difficulties were encountered?

Inspector's Initials _____

This Inspection Report is the responsibility of the Kitchen Equipment Supplier and the General Contractor. Coordination between the two parties is mandatory. Neither the Architect nor the Kitchen Consultant need to be present at any of the inspections.

EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE CONSULTANT.

- C. Review critical systems/components for application, performance and capacity and submit calculation worksheets with initial submission of brochure/rough-in drawings, with all proposed adjustments noted, including:
 - 1. Exhaust hood removal/supply air volume, velocity, static pressure, duct collar sizes and locations.
 - 2. Refrigeration Systems (compressor, condenser and evaporator) capacities/sizes, quantities and refrigerant piping distances/sizes.
 - 3. Exhaust Hood Fire Suppression Systems (nozzle locations, air handler and fuel interlocks, piping/distance limitations).
 - 4. Locations of Vacuum Breakers.
 - 5. Conformance of Refrigerated Components/Equipment with HACCP Guidelines (e.g., salad/sandwich pans, upright/open refrigerator cabinets, salad bars) with HACCP Guidelines.
 - 6. Gas, water line sizes and manifold configurations.
 - 7. Diameter and length of flexible connector lines for fixed/movable gas appliances.
 - 8. Fabricated Equipment load center panels (individual and total amperage calculations and circuit balance).
 - 9. ADA compliance of workstations, service positions, passageways, etc.
- D. Ceiling mounted appliances/fixtures: verify and coordinate dimensions/location of support framing/hangers with General Contractor. All material and installation below 12'-0" aff.: Section 11 4000.
- E. Dimension Responsibility: obtain actual or guaranteed measurements for proper fit of equipment. All dimensions indicated in Contract Documents are approximate and are as accurate as can be determined at the time. Field-check all horizontal/vertical measurements and conditions at the building prior to fabrication or delivery of equipment and notify the Architect of all conflicts or deviation from the dimensions shown.
- F. Checking Dimensions at Site: before ordering any materials or doing any work, verify all measurements of the building and be responsible for the correctness of them. No extras will be allowed for variations from drawings in existing conditions or for work performed under this contract. Any discrepancies found shall be submitted to the Architect for instructions before proceeding.
- G. Scheduling to Fit Openings: Should it become necessary to schedule the construction of walls or partitions before delivery of fixed equipment, the equipment must be fabricated for passage through finished openings. Maintain close contact with the project and be cognizant of all conditions, including vertical handling limitations within the building (elevator cabs or openings, stairs, etc.) and possible hoisting requirements. Coordinate all procedures with General Contractor and Project Team.
- H. Refrigerated and Dry Storage Areas: verify and coordinate dimensions to accommodate scheduled modular shelf sections. Notify Architect of variance between the Contract Documents and actual conditions.
- I. Color/Pattern Selections: submit selection samples of solid polymer products, plastic laminate, paint or stain finishes and vinyl-coated surface material of equipment as selected by Owner.
- J. Movable Equipment Interface: rolling stock (pan racks, carts, dollies, dish/tray/rack dispensers) required to fit through or into fixed equipment (roll-in refrigerators, counter bodies, etc.) is to be reviewed and coordinated for compatibility at time initial of shop drawing submittal. Indicate conflicts and proposed adjustments.

- K. Relocation of Work: relocate or re-route work as required to coordinate related items free of charge if no extra work is involved.
- L. Contractor must provide an Itemized Schedule of Values that correlates with the foodservice equipment item numbers for verification prior to submittals being submitted.

1.12 EQUIPMENT FURNISHED / INSTALLED BY OTHERS

- A. Obtain and coordinate utility requirements of Owner-Furnished/Owner-Installed (OF/OI) equipment with the building utilities and roughing-in drawings/provisions.
- B. Coordinate physical data of OF/OI appliances or equipment and incorporate information into Submittal Drawings. Vendor- or Purveyor-Furnished equipment (e.g., coffee/tea equipment): same as OF/OI.

1.13 WORK INSTALLED BUT FURNISHED BY OTHERS

- A. Coordinate delivery/installation schedule of Owner-Furnished/Contractor-Installed (OF/CI) equipment with Owner not less than ninety (90) days before equipment requirement.
- B. Obtain and coordinate utility requirements of OF/CI equipment with the building utilities and roughing-in drawings/provisions.
- C. Receive at job-site and fully incorporate into installation procedures as if furnished under this Section.

PART 2 - PRODUCTS

2.1 FABRICATED FIXTURES MATERIAL / COMPONENTS

- A. Stainless steel sheets or shapes: 18-8, Type 302, polished to 180 grit No. 4 finish.
 - 1. Stainless steel joints and seams: heli-arc welded, free of pits and flaws, ground smooth and polished to No. 4 finish.
 - 2. The "grain" direction of horizontal stainless-steel surfaces: longitudinal, including the backsplash. The polishing procedure at right-angle corners of fixtures shall provide a mitered appearance.
- B. Galvanized Iron Sheets: Armco copper bearing Zinc Grip or Zinc Grip/Paint Grip.
 - 1. Galvanized iron joints and seams: arc-welded, free of pits and flaws and ground smooth.
 - 2. Galvanized sheets or shapes: washed with mineral spirits and painted with Rustoleum gray semi-gloss enamel.
- C. Sound Deadening: Schnee Butyl Sealant 1/2" wide rope positioned continuously between all frame-members or contact material and underside of stainless steel surface (sinks, table tops, food wells, overshelves and undershelves). Tighten stud-bolts for maximum compression of sealant and trim excess.
- D. Plastic Laminates: color/pattern selected by Architect, in 1/16" thickness for flat surfaces: 1/32" thickness for radiused surfaces. Plastic laminates and adhesives must be N.S.F. approved (Standard No. 35).

- E. Solid Polymer products: color/pattern/material as selected by Architect in thickness as specified. Solid Polymer and adhesives must be N.S.F. approved (Standard No. 51).
- F. Casters.
 - 1. Fabricated fixtures with "Open Base" construction: Jarvis and Jarvis Model No. 5-405-113P-NSF swivel casters with grease seals on forks and wheels; Zerk fitting in swivel; two casters: Model No. E-75 Vertilock brakes. All casters: B-7" rolling bumpers with stainless steel top discs.
- G. Cutting Boards: 1/2" thick Read Products, Inc. "Richlite" cutting board, size as indicated.
- H. Identification Plates, Labels, Tags:
 - 1. Prohibited Information: names of suppliers, fabricators and contractors.
 - 3. NSF Labels: required on all pieces of equipment.
 - 4. Required Information: function or purpose of controls such as display light switches, food warmer controls, etc.
 - 5. Plate Construction: engraved phenolic plastic, secured to equipment with epoxy cement or stainless-steel screws. Furnish samples.

2.2 PLUMBING / MECHANICAL REQUIREMENTS

- A. Plumbing Fittings and Components: furnished under this Section as follows:

Note: Fitting and components described in Items 1, 2, 3,4 and 5 are furnished loose for installation by Division 22.

- 1. Control valves, appliance pressure regulators for water, gas and steam, and vacuum breakers: wherever required on Foodservice Equipment (chrome-plated where exposed).
- 2. Faucets and drains without connected overflows (unless otherwise indicated) for all sinks.
- 3. Specialty Foodservice water-fill faucets or hose assemblies indicated in drawings/specifications.
- 4. Wade Model No. W-10 Shock-Stop shock absorbers for all Foodservice Equipment with quick-opening or solenoid-operated water valves.
- 5. Dormont Stainless Steel Water Quick Disconnect hose, diameter per water connection size requirements, with SafetyQuick safety fitting, w/coiled restraining device, full port ball valve, antimicrobial coating, lifetime warranty.
- 6. Extensions of indirect waste fittings to open-sight floor sink or floor drains from sinks, under bar equipment, and food-holding components of serving counters (e.g. cold pans, hot food wells, refrigerator/freezer coils not equipped with condensate evaporators) furnished and installed by Division 22. Drains: painted with aluminum paint where exposed, type "K" copper where concealed.
- 7. Piping brackets and supports beneath/within fabricated equipment.
- 8. Closed Base Bodies: removable 18-gauge stainless steel closure panel at plumbing penetrations, under top.
- 9. Control valves on Open Base fixtures: mounted on 14-gauge stainless steel gusset-shaped panel with 3½" setback from counter top edge/rim to face of control handle.
- 10. Fill hose/faucet at support pedestals or Closed Base Body: installed in a 15" x 18" x 5" deep recessed mounting panel. Panel bottom: sloped on a 60o angle, with 3/8" stainless steel rod hanger-bracket for hose.
- 11. In-line water filter system:

- a. 3M or Everpure System filters for coffee/tea brewers, icemakers, water chillers, convection steamers and beverage systems. Sized per manufacturer recommendation.
- B. Gas-Heated Equipment Fittings and Components: furnished under this Section as follows:
1. Fixed Equipment: Dormont MFG brand "KITCF" Series gas hose kit with Quick Disconnect fitting at appliance. Approved equal: T&S Brass. Diameter per fuel volume/connection size requirements. Gas valve diameter size per fuel volume/connection size requirements.
 - a. Restraining device: heavy duty steel cable, fastened to equipment and walls, 3" to 6" shorter than equipment connector length.
- C. Final Plumbing Connections Provisions.
1. Fabricated equipment containing components, fittings and/or devices indicated on Foodservice Connection Drawings to be connected to the building systems: each component, fitting or group thereof pre-piped to a utility compartment for final connection by Division 22. Refer to drawings for capacities.
 2. Field-assembled equipment (e.g., prefabricated walk-in refrigerator/freezers, exhaust hoods, warewash machines, convection ovens, etc.): plumbing components completely interconnected under this Section for final connection arrangements indicated on Utility Connection Drawings.
 3. All plumbing final connection points of equipment shall be tagged, indicating:
 - a. Item number.
 - b. Name of devices or components.
 - c. Type of utility (water, gas, steam, drain, chilled water).
- D. Ducts and Vents.
1. Exhaust hoods which are furred-in to ceiling: 2" high duct collar for final connection to duct system.
 2. Warewash machines equipped with integral vent cowls or extended hoods: furnished with 18-gauge stainless steel seamless duct risers to 6" above finish ceiling for final connection. The duct: trimmed at ceiling with 16-gauge stainless steel angle flange with all corners welded.

2.3 FOODSERVICE EQUIPMENT REFRIGERATION SYSTEMS

- A. Install complete with all refrigerant, oil, dials, dehydrators, gauges, controls required for the proper operation of the system.
- B. Self-contained or factory-installed compressors: check and adjust to proper operating temperature prescribed by FDA/HACCP.

2.4 PLUMBING TRIM

- A. Faucets: furnished for all sinks or equipment requiring open water supply.
- B. Fill Faucets: furnished for appliances requiring open water supply.
- C. Drain Fittings: furnished for all sinks or equipment requiring removal of liquids. Install specified chrome-plated or stainless-steel fittings in die-stamped openings with washers

and locknuts. Solder may be used as a sealer but shall not be applied to the top surface of the drain fittings.

2.5 ELECTRICAL REQUIREMENTS

- A. All electrical systems, components and accessories within the work of this Section: certified to be in accordance with NEC 70.
- B. Electrical Fittings and Components: furnished under this Section as follows. Coordinate foodservice equipment loads, voltage and phase with building system and confirm any existing or OF/OI equipment requirements.
- C. Cord and Caps.
 - 1. Coordinate all Foodservice Equipment cord/caps with related receptacles.
 - 2. All 120 volt "plug-in" equipment shall have Type SO or SJO cord and plug with ground wire fastened to frame/body of item.
 - 3. Cord lengths for fixed equipment: adjusted to eliminate loose-hanging excess.
 - 4. All non-fixed plug-in "buy-out" equipment: Hubbell configuration, ratings as required.
 - 5. All mobile electrical support equipment (heated cabinets, dish carts, etc.) and counter appliances mounted on mobile stands (mixers, food cutters, toasters, coffee makers, microwave ovens, etc.): 8'-0" cord length with cord-hanger strap secured to rear of equipment or mobile stand.
- D. Switches and Controls.
 - 1. Each motor-driven appliance or electrically heated unit: equipped with control switch or starter per Underwriters' Laboratories, Inc. with low-voltage and overload protection.
 - 2. Disposer controls recess-mounted in wall: external fittings and accessories removed from enclosure and furnished with 16-gauge stainless steel perimeter angle flange with welded corners. Install control at 4'-0" aff to bottom of enclosure.
 - 3. Disposer controls recess-mounted in counter-splash risers: external fittings and accessories removed from NEMA 4 enclosure and furnished with 16-gauge stainless steel perimeter angle flange with welded corners. Install control at 3'-0" aff to bottom of enclosure. Provide panel with 60" long coil of Seal-Tite electrical conduit, from bottom of control panel for final field connections under Division 26.
 - 4. Equipment which is not provided with built-in circuit breakers or fused terminal block and is indicated on Utility Connections Drawings to be directly-connected to the building electrical system: a NEMA 4 stainless steel disconnect switch furnished and installed by Division 26.
 - 5. All remote manual starters, disconnect switches, magnetic contactors or starters and push-button stations: NEMA Type 4 enclosure; NEMA Type 1 enclosure only when installed in a Closed Base Body.
- E. Heating Elements.
 - 1. Electrically-heated equipment: thermostatic controls.
 - 2. Water heating equipment: equipped with positive low water shut-off.
 - a. Receptacles and Switches.
 - 3. Receptacles installed in vertical panels of support pedestals or Closed Base Bodies: installed in 12" x 8½" x 3" deep recessed mounting panel sloped on 60o angle and turned up to top of opening.

4. Pre-wire receptacles in closed base fixtures to a junction box installed within 6" from bottom of utility or compressor compartments.
5. Receptacles mounted on Open Base fixtures: installed on 12" x 10½" x 4½" deep 14-gauge stainless steel panel with returned ends and sloping recess. Secure panel to underframe of fixture top.
6. Pre-wire receptacles on open base fixtures to a junction box secured to a leg or mounted on underside of lower shelf. Vertical runs of wiring: made in rigid conduit or within the tubular leg.
7. Receptacles installed in/on-fabricated equipment: Hubbell, Inc. assemblies horizontally-mounted in a metal box with stainless steel cover plate.
8. Switches installed in/on-fabricated equipment: Hubbell, Inc. with metal box and stainless-steel cover plate. Switches: pre-wired to the controlled device and to a junction box installed within 6" from bottom of utility or compressor compartment. All refrigeration system switches: installed within the compressor compartment near the door opening.
9. Load centers installed in/on fabricated equipment to have all fixture components pre-wired to load center with balanced phase loading. Load center: ready for final connection by Division 26 and flush-mounted within utility compartment rear panel, set back 8" from access door. All breaker/device information: typewritten on circuit schedule in load center door (number corresponding breaker/device) with enclosed schematic wiring diagram of fixture components.
10. All receptacles to be pre-wired to cord and plug assembly and routed through overshef post at all island equipment locations, unless specified otherwise.

F. Light Fixtures.

1. Light fixtures with lamps installed in/on fabricated or field-assembled equipment: pre-wired to a junction box for final connection (continuous-run fixtures when indicated).
2. LED Display Light: install light fixtures full-length of Display Stand and Serving Shelf with stud bolts and pre-wire through support posts to an apron-mounted switch.
3. Heat Lamps: installed to underside of serving shelf assemblies. When multiple 24" heat lamps are specified, provide maximum length heat lamp chassis. Install all switches remote from lamps.
4. Cold Storage Light Fixtures: Furnished by Section 11 4000 and installed by Div. 26. All electrical wiring and conduit provided by Div. 26. electrically connected through the Vapor proof light fixture base connection, located on the interior door header. Door frame wiring stubs out top of panels 8" in flexible conduit for final connection by electrical contractor. All horizontal conduit: above ceiling panels. Install plastic sleeve through ceiling panels for electrical conduit. Seal sleeved penetrations airtight at both sides of panel. All penetrations to be sealed by Kitchen Equipment Contractor. All Cold Storage light fixtures to be LED.

G. Final Electrical Connection Provisions.

1. Fabricated equipment containing electrically-operated components or fittings indicated on Utility Connections Drawings: direct-connected, with each component, fitting or group pre-wired to a junction box for final connection by Division 26. Refer to drawings for circuit loading.
2. Fabricated equipment containing electrically-operated components and/or devices indicated: circuit-breaker load center with each component or device pre-wired to a separate circuit breaker for balanced phase loading and single final connection by Division 26.
3. Field-assembled equipment (e.g., prefabricated cold storage assemblies, exhaust hoods, warewash machines, etc.) shall have electrical components completely

interconnected in this Section for final connection arrangements as indicated on Utility Connection Drawings by Division 26.

4. Pre-wire the following groups of cold storage assembly electrical devices to a top-mounted junction box for final connection by Division 26 per compartment grouping (unless otherwise indicated).
 - b. Light fixtures and switches; heated pressure-relief vent.
 - c. Door/jamb heaters.
 - d. Evaporator fans, defrost elements and drain line heaters.
 2. All electrical final connection points of equipment shall be tagged, indicating:
 - a. Item number.
 - b. Name of devices on circuit.
 - c. Total electrical load.
 - d. Voltage and phase.
- H. Lamps: in all Foodservice Equipment containing light fixtures. Refrigerator or heated cabinets: All exposed LED lamps above or within a food zone: Shat-R-Shield lamps or standard lamps, sleeved with end caps.

2.6 CUSTOM - FABRICATED / ASSEMBLED UNITS

- A. Mechanical or electrical operating components or products integrated into a fabricated fixture: ventilation and service access required or recommended by the manufacturer. The service access panel(s) size and placement is to permit easy lubrication, adjustment or replacement of all moving parts and is to be indicated on fabrication shop drawings.

2.7 BAKER TABLE TOPS (Unless specified otherwise)

- A. 14-gauge 304 S/S top with 2" square turn down at front, 6" high enclosed splash at three (3) sides and rear. Brace same as "Counter/Table tops".
- B. 1¼" x 6" high integral coved riser at rear and ends unless indicated otherwise on drawings.
- C. 16-gauge stainless steel flour-trough at free long sides, secured to underside of top. Trough: 3" diameter with eased edges/corners.

2.8 COUNTER / TABLE TOPS

- A. 14-gauge stainless steel; all free edges turned down 2" with ¾" tight hem at bottom. Free corners: rounded on ¾" radius.
- B. Marine edges: turned up ½" on 45° angle and turned down 2" with ¾" tight hem at bottom.
- C. Cafeteria serving counter tops at hot food stations: full-length x 3½" x ½" high raised rail at (customer's) front side with 45° integral turndown to counter surface.
- D. Tops abutting high fixtures or walls: cove up specified height and slope back 1½" at top on 45° angle; 2½" slope where piping occurs. Turn down 1" at rear of splash and close ends to bottom of top turndown. Secure splash turndown to wall with 4" long 14-gauge stainless steel "Z" clip anchored to wall, 36" o.c.
- E. Freestanding tables and all serving counter splash-risers: turned back on 90° angle with 1" turndown at rear.
- F. Brace tops with rigid-welded 1½" x 1½" x 1/8" galvanized steel angle frame at perimeter with cross bracing 2'-0" o.c. maximum. Provide 4" x 4" x 12-gauge stainless steel triangular pads where leg gusset welds to frame. Paint entire frame with Rustoleum gray

semi-gloss enamel. Angle frames: secured to underside of top surfaces with $\frac{1}{4}$ " studs welded 9" o.c. maximum with chrome-plated washer, lock washer and capnut. Studs: such length that cap nuts can be made-up tight, bringing top down snugly on angle frame eliminating all vibrations or "oil-canning".

- G. Tops: $1\frac{1}{2}$ " overhang at free sides of underframe or Closed Base Body.
- H. Mockett Model No. SG5-26 chrome-plated/plastic grommet assembly or integrally-welded stainless-steel flange or inverted gusset where service utilities or support posts penetrate or abut tops, ground and polished to match top. When conditions permit, provide a 1" x $1\frac{1}{2}$ " rectangular opening in the backsplash for service utilities in lieu of piercing the horizontal surface. Install stainless steel split-tubing at raw-edge of opening.
- I. Extend underbracing members to wall, turn down 6" and anchor to wall when specified to be mounted on leg/bracket assembly.
- J. All openings in tops: $\frac{3}{16}$ " high raised die-formed edges.
- K. All top openings for pans or inserts: 20-gauge stainless steel, watertight liners, $8\frac{1}{2}$ " deep, secured to underside of counter top.
- L. All "built-in" and "drop-in" counter equipment/appliances: with framing members at perimeter of opening.
- M. Scrap Container: 18-gauge stainless steel construction $6\frac{1}{2}$ " x $6\frac{1}{2}$ " x $21\frac{3}{4}$ " long. Top of container: $\frac{5}{8}$ " wide x $\frac{1}{4}$ " high full perimeter flange with $\frac{1}{4}$ " diameter stainless steel rod bail handle. Interior vertical corners coved on $\frac{1}{2}$ " radius. Counter top: fitted with $6\frac{3}{4}$ " square die-stamped opening.

2.9 COLD PANS

- A. 14-gauge stainless steel with $\frac{3}{4}$ " coved interior welded integrally to counter top with $\frac{3}{16}$ " raised edge at perimeter of opening. Depth of Cold Pan: NSF 7 compliance.
- B. Slope bottom to required quantity of Component Hardware Model No. E16-4021 drain fittings at 48" o.c. maximum. Sleeve through insulation at drain fittings and extend common drain line into utility compartment for indirect waste connection.
- C. $\frac{1}{2}$ " o.d. copper refrigerant lines in serpentine patten, $1\frac{1}{2}$ " o.c. flattened for maximum contact. Secure tubing to underside of $\frac{1}{4}$ " thick aluminum "distribution plate" installed tight to underside of frost plate area and apply cold-conductive mastic to all surfaces.
- D. Component Hardware Model No. E16-4021 drain fittings at 48" o.c. maximum, sleeved through insulation with common drain line extended into utility compartment.
- E. Heat Cable: low-wattage, full-perimeter, below counter top at edge of depression. Secure with "Z" clips, 9" o.c. and interwire with compressor switch for simultaneous operation.
- F. Enclose sides and bottom of pans with airtight 18-gauge galvanized jacket and pack with 2" fiberglass insulation set in mastic.
- G. Compressor: size as indicated or required to accommodate size of cold pan. Locate compressor in compressor compartment below unit or as indicated on drawings.

- H. Sectional 16-gauge stainless steel perforated false bottom ($\frac{1}{4}$ " holes, @ $\frac{3}{4}$ " o.c.). Turn down $1\frac{1}{2}$ " all sides, weld corners and provide finger rings. False bottom sections: 24" long maximum.

2.10 DRAWERS

- A. Liners: Component Hardware Model No. S81-2020C (20" x 20") S/S liner, easily removable with drawer in fully extended position.
- B. Drawer Frame: 16-gauge stainless steel flanged out at top. Weld the frame to double-paneled 16-gauge stainless steel drawer front with full-length recessed pull at top (similar profile as Garcy Model No. R-1060) with closed ends.
- C. Channel-formed horizontal pull: $\frac{3}{4}$ " turndown at front and ends with $\frac{1}{2}$ " tight hem. Front edge of pull: flush with face of drawer. Recess behind pull: sloped up on 60o angle, terminating 1" below bottom edge of pull.
- D. Mount drawer frame on Component Hardware Model No. S52-2020 self-closing slides, with Delrin bearings, full-depth of fixture. Secure slides to body or brackets to eliminate lateral movement in extended position. Refrigerator drawers: Component Hardware Model No. S52-2024 stainless steel slides with Delrin bearings.
- E. Drawer enclosure in an Open Base Fixture: 18-gauge stainless steel flanged out at top for attachment to underside of table top. Lower edge of enclosure is flanged in toward open bottom. Mount drawer slides to enclosure and brace as required. Face of enclosure is to be same length and height of drawer face. Provide $\frac{3}{4}$ " deep offset in front of enclosure and $2\frac{1}{2}$ " from underside of table top for flush-fitting appearance. Drawer enclosure on freestanding fixture: full-depth of table framing.
- F. Drawer enclosure in a Closed Base Fixture: completely partitioned from adjoining area. Drawer front: flush-fitting with face of body.
- G. Drawer Liners other than tool/utility: **Bread Drawer:** S/S drawer liners sized to fit drawer; **Refrigerated Drawer:** S/S drawer liners sized to fit drawer.
- H. Cash Drawer: integral stainless steel body, 3" deep.

2.11 FOOD WELLS (UNLESS SPECIFIED OTHERWISE)

- A. Food Warmer Controls: remote-mounted in sloping recessed apron panel. Control panel is recessed $2\frac{1}{2}$ " from bodyline at top of 60o slope, 1" at lower edge. Terminate slope angle $2\frac{1}{2}$ " below counter top. Mount panel on concealed piano hinge at bottom edge; secure with screws at upper corners.
- B. Manifold all warmer drains and extend to within utility compartment for indirect waste connection. Install valve in drain line and extend handle through compartment door.
- C. Removable 18-gauge stainless steel closure panel at underside of warmers.
- D. 14-gauge stainless steel plate/utensil shelf full-length of hot food station unless noted otherwise: 10" below counter top x 9" deep, with rear panel coved up to underside of counter top; end panels turned up square. Front of shelf: turned down $1\frac{1}{2}$ " and returned under for closure panel attachment.

- E. Food wells: Hatco Model No. HWBIBRT-FULD insulated food warmer (1200 watts, 208 volts, single phase) secured to underside of 12" x 20" die-stamped counter top openings with thermal breaker mastic rope applied at perimeter of food well flange.
- F. F. Soup Warmers: Hatco Model No. HWB-11QTD soup warmer secured to underside of 11" diameter die stamped counter top opening with thermal breaker mastic rope applied at perimeter of soup well flange. Maximum allowable temperature of counter top at contact surface: 120oF. Each warmer: equipped with one 11-quart stainless steel round insert and slotted cover.
- G. When specified: 5/8" deep recess in counter top full-length of pan-opening or as shown, with equal-length removable 3/4" thick Read Products "Richlite" cutting board sections, 42" long maximum. Recess and board: spaced 2" from front edge of pan opening and extended to leading edge of counter top.

2.12 SINKS

- A. 14-gauge stainless steel; all interior corners (horizontal/vertical) covered on 3/4" radius. 1 1/2" wide double-walled partitions with flat tops between compartments.
- B. Continuous exterior panels of multiple-compartment sinks: 14-gauge stainless steel filler panel welded, ground and polished between compartments.
- C. Sinks (with overflow): score and slope sink bottom 1/2" to die-stamped opening fitted with Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. 14-gauge stainless steel bracket: welded to sink bottom for drain stem with 1 1/2" handle clearance.
- D. Where sinks are installed in fixture with Closed Base Body, provide a Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. (Sinks with dimension larger than 20" x 20" in Closed Base Body will not have overflow fitting.) 14-gauge stainless steel bracket: welded to sink bottom with T & S Model No. BL-4740-1 guide bushing. Install on shortened drain stem, one T & S Model No. BL-4710-1 remote control stem assembly only (length as required) with Model No. 113-L universal joint and white blank button. Set drain control handle in Cambro Model PSB-6 bowl with bottom omitted (dress raw edge) to permit passage of drain handle. Secure bowl in utility compartment door or body panel with clear silicone.
- E. When single-hole deck-mounted faucets are specified, install overflow fitting in sidewall of sink compartment and provide ell-fitting in connecting tubing.
- F. Flush Covers when specified: 1/2" thick Read Products, Inc. "Richlite" cutting board, size as indicated. Support clips: 1/4" stainless steel rod 2" long, formed at 45° with two 3/4" leg ends (1/4" long threaded ends). Insert rod-clips through tight-clearance holes in sink, seal watertight and secure with stainless steel acorn-nuts or tack-weld at exterior of sink wall. Set support clips 1/2" below top. Provide 14-gauge stainless steel channel or angle support frame to store covers when not in use. Cover holder: adjacent to sink compartment, below counter top or under drawer assembly.

2.13 TRAYSLIDES (UNLESS OTHERWISE SPECIFIED)

- A. Trayslides: 12" wide, solid 16-gauge stainless steel turned up 2" at rear behind counter top turndown; turned down 4" at front and free ends, unless otherwise indicated.
- B. Three 1/4" high die-formed inverted "vee" ridges at 4" o.c., 2" from leading edge, terminating 2" from ends of trayslide with tapered ridge-ends.

- C. Ridges formed on radius: equal-length segments with 2" separation between chords.
- D. Secure trayslides to counter-top/body frame, same as "Counter Tops." Enclose exposed underside of trayslide with 18-gauge stainless steel.
- E. When indicated, project trayslides 2" beyond serving counter top and return the full-width of serving counter at free ends.
- F. All trayslides to be provided and mounted per ADA requirements.

2.14 DISHTABLES

- A. Soiled/clean dishtable: 14-gauge stainless steel; free edges coved up 3" with 1½" diameter rolled rim and bullnosed corners.
- B. Edge of dishtables next to high fixtures or walls: coved up 10" and sloped back 1½" on 45° angle; 2½" slope where piping occurs. Turn down 1" at rear of splash and secure to wall with 4" long 14-gauge stainless steel "Z" clips anchored to wall, @ 36" o.c.
- C. Exposed rear splash: 16-gauge stainless steel finish panel from top of splash to bottom edge of rolled rim with welded vertical joint at end. Secure panel with concealed attachment and install bracing 24" o.c.
- D. Cove all interior corners (horizontal/vertical) on ¾" radius and slope tables 1/8" per foot to sinks, scuppers or warewash machines, maintaining level crown/splash.
- E. Brace dishtables with 1" x 4" 12-gauge stainless steel channels down centerline of top and between each pair of legs, with closed ends. Bracing: secured to underside of dishtable with ¼" studs welded 6" o.c. maximum, with chrome-plated washer, lock washer and cap nut. Studs: such length that the cap nuts can be made up tight, bringing the dishtable down on the channel-members, eliminating all vibration and "oil-canning."
- F. Integrally-welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops; ground and polished to match top.
- G. Hose Bibb: Chicago Model No. 305VBRFCF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8" stainless steel rod hose hanger.
- H. Extend underbracing members to wall, turn down 6" and anchor to wall when specified to be mounted on leg/bracket assembly.
- I. Paper-Drop Opening: 9" square with 4" integral chute having hemmed bottom edge. Slope dishtable top 1" toward opening, forming a 16" square tapered deposit point.
- J. Accessible Tray-Drop Opening: 10" x 18" with integral 16-gauge stainless steel seamless chute sloped on 45° angle toward center of mobile soak sink position.

2.15 DISH / TRAY DEPOSIT ASSEMBLY

- A. 14-gauge stainless steel deposit shelf, size as indicated. Extend shelf through opening, flush with public side of partition, height as required by local code authorities. Turn shelf down 1" at front with ¾" return at bottom (either scribed into partition or forming reveal). Shelf: 1" square turndown at rear long side, integral with conveyor slider pan, tray-accumulator or dishtable. Extend rear/end splash to align with head of deposit station

opening. Modify rolled rim at the operator's side of the tray drop window to have a 3" rolled rim.

- B. 18-gauge stainless steel window frame with perimeter flange channel-formed 1" x 3/4" at both sides of wall. Weld all corners of frame and install with concealed attachment. Align/abut one jamb of frame with end splash of conveyor slider pan or dishtable whenever adjacent.

2.16 UTENSIL - WASH COUNTERS

- A. 14-gauge stainless steel; all free edges covered up 3" with 1 1/2" diameter rolled rim and bullnosed corners.
- B. Edges of utensil-wash counters next to high fixtures or walls: covered up 10" and sloped back 1 1/2" on 45° angle; 2 1/2" slope where piping occurs. Turn down 1" at rear of splash and secure back splash to wall with 4" long 14-gauge stainless steel "Z" clip anchored to wall @ 36" o.c. Vacuum breaker pockets: 4" long square turnback sections, aligned with slope breakline.
- C. Exposed Rear Splash: 16-gauge stainless steel finished panel from top of splash to bottom edge of rolled rim with welded vertical joint at end of splash and 1/2" turnback at bottom of panel. Secure panel with concealed attachment and install bracing 24" o.c.
- D. Cove all interior corners (horizontal/vertical) on 3/4" radius and slope tables 1/8" per foot, maintaining level crown.
- E. Brace utensil-wash counters with 1" x 4" 12-gauge stainless steel channels down centerline of top and between each pair of legs, with closed ends. Bracing: secured to underside of dishtable with 1/4" studs welded 6" o.c. maximum, with chrome-plated washer, lock washer and cap nut. Studs: such length that the cap nuts can be made up tight, bringing the dishtable down on the channel-members, eliminating all vibration and "oil-canning."
- F. Integrally welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops: ground and polished to match top.
- G. Extend underbracing members to wall, turn down 6" and anchor to wall when specified to be mounted on a leg/bracket assembly.
- H. Hose Bibb: Chicago Model No. 305VBRCF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8" stainless steel rod hose-hanger.

2.17 DOORS

- A. 18-gauge x 1" stainless steel double pan-formed welded construction, insulated with 1" thick polyurethane boards. Seal perimeter joint of pans. Offset lower horizontal framing member of Closed Base Body to align flush access door with bottom of Body.
- B. Channel-formed full-length horizontal recessed pull: 3/4" turndown at front and ends with 1/2" tight hem. Front edge of pull: flush with face of door. Recess behind pull: sloped up on 60° angle and terminated 1" below bottom edge of pull.
- C. Door Hardware:
 - 1. Two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge location).
 - 2. Component Hardware Model No. 35-2000 concealed Magnetic Catch.

3. Component Hardware Model No. D30-4780 lock in upper free corner of door.
- D. Louvered opening: cutout opening size as indicated, turn in 1" and weld. All corners: ground and polished.
 1. Full-height 18-gauge stainless steel louver with 1" vanes at 45°, ½" spacing. Perimeter channel-formed frame: 1½" x 1".
 2. 45° x 1" x ½" x opening width plus ½" 18-gauge stainless steel louver.
 3. Tack weld tab of louver flange to back panel of door.
- E. Drain handle opening: 6" diameter hole through double pan to accommodate Cambro Model No. PSB-6 Bowl.
 1. Secure bowl to door panel with clear silicone.
 2. Omit bottom of bowl. Dress raw edges of opening for passage of drain handle.
 3. Exposed insulation at penetration of door pan: painted black.
- F. Sliding Doors: fabricate same as Paragraph "A."
 1. Aluminum Sliding Door Track: Component Hardware Model No. B57-0000 Series, length as required. Secure to angle frame at top of underside.
 2. Front/rear door sheaves: stainless steel ¾" side mounted door hangers; two (2) required per door.
 4. Recessed Vertical Pull at Upper Corner of Door: Component Hardware Model No. P63-1012.
 5. By-Passing Door Guides secured to bottom shelf: Component Hardware Model No. B62-1093.
 6. Door Stop at bottom edge of door: Component Hardware Model No. B60-1086.
- G. Offset lower horizontal framing member of Closed Base Body/utility compressor compartment to align door flush with bottom of Body.

2.18 CLOSED BASE BODIES

- A. Frame: rigid-welded 1½" x 1½" x 1/8" galvanized steel angle forming a continuous structure around the top and bottom perimeters of the fixture, a post at each corner, studs spaced 48" o.c. maximum. Top of frame is cross-braced with 1½" angles, 2'-0" o.c. maximum.
- B. 18-gauge stainless steel panels and trim with concealed attachment. All seams: welded, ground and polished.
- C. Exposed Vertical Corners: rounded on ¾" radius. Closed Base Bodies adjacent to walls or fixtures: square corners.
- D. Vertical and horizontal channel members at shelf interior or drawer enclosures, such as corners and center mullions: closed and sealed
- E. Closed Base Bodies set on finished masonry platforms: closed and caulked at underside of equipment overhang and bolted to platform. Body overhang of platform: 1" at free ends 2" at front and exposed rear sides.
- F. Closed Base Bodies not set on platform: Component Hardware Model No. A54-2-6, 6" legs spaced 5'-0" o.c. maximum.

2.19 COMPRESSOR COMPARTMENTS

- A. Same material as Closed Base Bodies with back and end partitions; omit bottoms only.
- B. 10-gauge steel slide out support: channel frame on full extension slides with 125 lb. minimum capacity secured to fixture frame with anti-vibration mountings for maximum sound deadening. Closed Base Body on solid platform: front-to-back slide out support channels set 4" above bottom for air circulation.
- C. Access Door: 18-gauge stainless steel double-pan type with channel formed horizontal recessed pull full length of top (similar profile as Garcy Model No. R-1060) with closed ends. Channel-formed horizontal pull: $\frac{3}{4}$ " turndown at front and face of door. Recess behind pull slopes up on 60o angle, terminating 1" below bottom edge of pull. Offset lower horizontal framing member of Closed Base Body to align flush access door with bottom of body. Door hardware: two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and Component Hardware Model No. 35-2000 concealed magnetic catch.
- D. Access Doors Louver: full-height, with $1\frac{1}{2}$ " x 1" x 18-gauge stainless steel channel-formed frame with welded corners. 18-gauge stainless steel louver. Submit sample of design for approval.

2.20 UTILITY COMPARTMENTS

- A. Closed Base Bodies or Pedestal Supports: fitted with utility compartments wherever piping or wiring is required in/on the fixture.
- B. Same material as Closed Base Bodies with full-height back and end partitions. Omit bottoms except at hose-reel locations.
- C. Access Doors: 18-gauge stainless steel double-pan type with channel formed horizontal recessed pull full-length of top (similar profile to Garcy Model No. R-1060) with closed ends. Channel-formed horizontal pull: $\frac{3}{4}$ " turn down at front of door, recess behind pull slopes up on 60o angle, terminating 1" below bottom edge of pull. Offset the lower horizontal framing member of the Closed Base Fixture to permit flush alignment of door with face and bottom edge of body. Door hardware: two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and one Component Hardware Model No. 35-2000 concealed magnetic catch.
- D. No shelves of Closed Base Fixtures are to be penetrated.

2.21 UTENSIL RACKS

- A. Rack: $\frac{1}{4}$ " x 2" 300 series stainless steel flat bar with No. 4 finish, fully welded and formed to match shape shown on drawings. Lowest band: 7-6 aff, unless otherwise indicated.
- B. Ceiling Mount Supports: 1-5/8" diameter 16-gauge stainless steel tubing from band to 18" above ceiling. Anti-sway bracing above ceiling: $1\frac{1}{2}$ " unistrut members. Tubing penetrations at ceiling: Component Hardware Model No. A16-0206 stainless steel gussets.
- C. Table Mount Supports: 1-5/8" diameter 16-gauge stainless steel tubing extended thru counter top. Secure to closed base framing or crossrail/undershelf on open base fixture. Tubing penetrations of counter tops: integrally welded stainless steel inverted gusset.

- D. Utensil Rack Hooks: Component Hardware Model No. J77-4401 stainless steel hooks spaced 8" o.c. maximum.
- E. Electrical Receptacle: NEMA No. 5-20-R or as noted. Mount in fully welded 3½" x 5½" x 3" 14-gauge stainless steel enclosure with ½" radius corners. Stainless steel cover plate to fit specified receptacle. Pre-wire thru tubular support for final connection above ceiling by Division 26.

2.22 CASHIER / SERVING COUNTERS

- A. Exterior Body Panels when specified: ¾" thick marine grade hardwood plywood with plastic laminate or solid polymer in Architect's selection of color/pattern at all exposed surfaces; backing sheet where concealed.
- B. Position, size and finish horizontal or vertical reveal as directed by Architect.
- C. Secure panels to counter body framing in concealed manner. Install removable panels with "Z" clips overlapping body framing members.
- D. Hinged doors in exterior body panel(s): Grass Model No. 1200VZ or 1200VZ8 self-closing hinges. Three (3) required per door; Grass Model No. G/HRZ base plate at each hinge; Ives Model No. TM820 concealed push latch at each door. Confirm Model No. and provide samples with submittal.
- F. Cashier counter to have 16-gauge s/s intermediate shelf, turned down 1 1/2" with tight hem at front. Cove up 2" at rear and sides. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at longitudinal centerline. Provide outlet for power/data within body located above intermediate shelf. Provide cash drawer inserts per district standards.

2.23 OPEN BASE STRUCTURES

- A. 1-5/8" o.d. x 16-gauge seamless stainless-steel tubing legs beveled at bottom. 1¼" o.d. crossrails fully-welded (360o smooth and polished) to legs at 10" aff, o.c.
- B. Top of Leg: inserted in Component Hardware Model No. A20-0206 gusset fully-welded to table frame or sink bottom.
- C. Bullet Foot: Component Hardware Model No. A10-0851.
- D. Freestanding fixtures requiring utility connections: Component Hardware Model No. A10-0854 flanged feet at the fixture corners, anchored to floor with non-corrosive bolts.
- E. Table Bases: maximum leg spacing of 6'-0" o.c.; dishtable and utensil wash counter bases at 5'-0" o.c.
- G. Open Base equipment specified to be supported by brackets at the rear side only (not completely cantilevered): tubular legs at front side only with Component Hardware Model No. A10-0854 flanged feet anchored to floor with non-corrosive bolts. Front-to-back crossrail: fitted into Component Hardware Model No. A20-0406 circular gusset secured to wall with non-corrosive bolts.

2.24 UNDERSHELVES

- A. Open Base Structures: 16-gauge stainless steel turned down 1½" with tight hem at bottom. Notch all corners to fit tubular legs and weld from underside to completely fill gap; grind and polish. Cove up 2" at rear or ends adjacent to wall, columns, refrigerators, etc. The

turn up at freestanding fixtures is to be hemmed tight to bottom of turndown. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at longitudinal centerline and at each intermediate pair of legs.

- B. Open Base Structure specified to be supported by brackets at rear side only (not completely cantilevered): 16-gauge stainless steel turned down 1 ½" at free sides with tight hem at bottom edge. Notch all corners to fit tubular legs as required and weld from underside to completely fill gap; grind and polish. Cove up 2" at rear ends, as indicated. Fill gap at front to back rail, grind and polish. Brace undershelf with 1" x 4" x 1" 14-gauge stainless steel channel at longitudinal centerline between front to back rails.
- C. Closed Base Fixtures: 16-gauge stainless steel turned down 1½" at front. Front edge of bottom shelf: turned back and sealed to finished masonry platform or boxed for leg application. Center shelf has ¾" tight hem.
 - 1. Shelves: turn up square at ends (coved up at rear only) to the shelf above or counter top flanged out for attachment with no open spaces at interior.
 - 2. All shelf partitions at exposed ends of cabinet bodies or interiors: free of exposed framing members.
 - 3. Reinforce shelves with full-length 1" x 4" x 14-gauge stainless steel closed hat channel.
 - 4. Unless otherwise noted, all closed base undershelves are to be 22" deep, clear.
 - 5. Fully weld smooth and polish, the vertical seam of shelf turndown/turn up with face of body partition.
 - 6. Seal the vertical seam of square turn-in at exposed interior of open shelf sections.

2.25 ANCHOR PLATES / WOOD GROUNDS

- A. Behind finish surface wherever building wall, partitions or ceiling construction will not accommodate direct attachment of equipment such as overshelves, wall cabinets, hose reels, utensil racks, exhaust hoods, display cases, etc. Material and installation by General Contractor. Location and coordination with trades by Section 11 4000.
- B. Anchor Plates: not less than 12" x 12" x ¼" thick steel, secured to the structure above or behind the finished surface, positioned at attachment points.
- D. Wood Grounds: length required by fixture, component or device, 24" wide x ¾" thick plywood secured to partition system prior to gypsum board installation.
- E. Above ceiling supports: structural shapes (4" x 8.0 lb. channel) suspended from structure. Maximum height 15'-0" aff. size: width of equipment x length of equipment plus 6'-0". Cross bracing at 6'-0" on center maximum.

2.26 OVERSHELVES

- A. 16-gauge stainless steel with free edges turned down 1" with ½" tight hem at bottom. ¾" radius at free corners.
- B. Turn up 2" raw at walls and sides with horizontal coved corner at rear. Round front corners of turn up on ¾" radius.
- C. Where shelf width exceeds 12" width, reinforce with ½" x 4" x 14-gauge stainless steel closed hat channel full-length of shelf.
- D. Wall-Mounted Shelves: 16-gauge stainless steel brackets 48" o.c. maximum, set in 6" from ends.

- E. Freestanding Shelves: where splash is required at free overshelves, turn up square 2" at ends, cove up at rear and hem tight to lower edge of front turndown. Weld exposed corners.
 - 1. Freestanding overshelves: 16-gauge stainless steel cantilevered brackets at rear of table; double-cantilevered brackets at center of table. Posts for cantilevered overshelves are 1-5/8" o.d. x 16-gauge stainless steel secured to underframe, 4'-0" o.c. Ends of shelves: secured to adjacent wall/fixture or mounted on 1 1/4" diameter stainless steel posts.
 - 2. Freestanding overshelves not on cantilevered brackets: 1 1/4" o.d. x 16-gauge stainless steel posts, each pair at 4'-0" o.c., maximum.
- F. Baker Table Overshelves: supported at 18" above top with 1 1/4" o.d. stainless steel tubular supports with channel shoe secured to risers.
- G. Glass/Cup Rack Overshelf at Dishtables: 14-gauge stainless steel with 1 1/2" deep "vee" trough at free long sides with 1" tight hem at inside of trough. Provide a 1/2" marine edge at free ends; 4" splash at wall. Suspend shelf at 18" above dishtable surface on posts/brackets anchored to dishtable frame/wall at rear; 1" o.d. stainless steel tubing supports from structure above ceiling at front edge, 60" o.c./each end.
 - 1. Install at both ends, 1/2" stainless steel drain-tube (connecting both vee-troughs) extended to dishtable surface through splash turnback.
 - 2. Rack-rest: horizontal full-length 1-5/8" o.d. stainless steel tubing supported at 10" o.c. above shelf (8" o.c. for double service shelf) by 1 1/4" o.d. stainless steel tubing with closed ends. Support tubing: welded, ground and polished, spaced 60" o.c.
 - 3. Rack-rest supports to wall: 4" x 4" x 10-gauge stainless steel flange plates welded to support tubing. Anchor flanged plates to blocking ground with non-corrosive bolts.

2.27 DRAIN TRENCH LINER / GRATING

- A. Liners: 14-gauge stainless steel in sizes as indicated.
- B. Interior of liners: 6" deep with all interior corners (horizontal/vertical) coved on 3/4" radius; sloped and scored 1" to integrally welded Component Hardware Model No. D34-Y011 basket drain assemblies @ 48" o.c., fitted with 6" long welded tailpiece. Stainless steel safety chain: connected to basket strainer assembly and top of liner wall.
- C. Liners: 1" wide perimeter shoulder at the top, turned up flush with finished floor, tight-hemmed back down to the shoulder level and flanged out 2" for attachment to the slab.
- D. Underside of sloping portion of liner: 2" long "Z" clips.
- F. Grating: IMC-TEDDY PFG-ADA removable fiberglass grating.
 - 1. 1" deep "I" bearing bars with 0.6" wide top flange.
 - 2. Full perimeter frame, section quantities and sizes indicated.
 - 3. Maximum of 2'-0" sections.
 - 4. Grating bars to be spaced 0.4" apart per ADA requirements.
 - 5. Grating to be two (2) equal sizes.

2.28 WALL PANELS

- A. Wall Panels: 18-gauge stainless steel, double pan-formed ½" thick with internal stiffener members. Fill with USDA approved thermal insulation, full height and width of panels, attach to interior with mastic. Maximum allowable temperature at rear side of panel: 120oF.
 - 1. Height of panels as required: top of tile base to underside of hood, top of tile base to top cap of stub wall or top of splash to underside of hood.
 - 2. Level and square lower edge and sides.
 - 3. Butt joint all panels.

2.29 EXHAUST HOOD (Surface - Mounted Condensate)

- A. Hoods: size/shape as indicated: 18" high at interior.
- B. Body: 16-gauge stainless steel, with all seams welded, ground and polished.
- C. Continuous condensate trough at perimeter: 3" x 1".
- D. Frame top of hood with ½" angle iron assembly and suspend from structure above ceiling by ½" diameter steel rods, drawn tight against finished ceiling surface.
- E. Duct opening/collar as specified with stainless steel louvered grille over opening.
- G. Div. 22 to extend drain line to floor sink. Drain line to be silver painted.
- H. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.

2.30 EXHAUST HOOD (UNLESS SPECIFIED OTHERWISE)

- A. Exhaust to be provided to meet local jurisdiction code requirements. Kitchen Equipment Contractor to verify code requirements and coordinate with Division 23 and 26. Hoods over production equipment to be Type 1 with continuous capture. All Type 1 hoods to be 6' deep to ensure smoke/steam capture unless notated otherwise
- B. Install fire suppression system(s) in all ventilators, specified in this section. Install in accordance with manufacturer's recommendations and applicable codes or standards. Submit installation certification form to Architect.
- C. Locate chemical cylinders as indicated on drawings and install piping to exhaust hood(s) in totally-concealed manner. Set cylinders and cabinets at 7"-0" clear AFF unless noted otherwise. Provide polished chrome plated tubing piping/fittings, where exposed at cylinder location and at interior of exhaust ventilator. Exposed pipe threads in/above food zone not allowed. Submit schematic diagram of installation and confirm critical distances from cylinders to nozzles.
- D. Remote manual release located in path of egress from protected exhaust hood area. Kitchen Equipment Contractor to coordinate location with local Fire Marshal requirements prior to submittal review. All conduits to be recessed within wall, SURFACE MOUNTING WILL NOT BE ACCEPTED.

- E. Provide one (1) handheld Type 'K' 6-liter fire extinguisher per Ansul system, surface wall mounted.
- F. Required quantity and sizes of mechanically-operated gas valves.
- G. Confirm interconnection of all equipment as required to ensure exhaust hood and fire suppression systems are completely operational and meet local jurisdiction code requirements.
- H. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
- I. Provide appropriate quantity of fire suppression systems as required by local jurisdiction code requirements.

2.31 HIGHLIGHTING

- A. Polish the following vertical surfaces to a No. 8 finish:
 - 1. Serving and display shelf turndowns.
 - 2. Conveyor and dish/tray deposit station turndowns/frame.
 - 3. Trayslide turndowns.

2.32 SHOP / FIELD JOINTS

- A. Field joints: least possible number, used only when equipment size must be limited for access into building or interior space.
- B. Stainless steel tops (including edges and splashes): fully welded, ground and polished to match adjacent surface.
- C. Vertical field joints of fixture backsplashes that are inaccessible from the back: terminate 1" above the horizontal covered corner. The remaining height of field joint: hairline butt joint with offset draw-angle behind. All horizontal/vertical draw-joints: located and noted on shop drawings.
- D. Hairline butt joint: 1½" x 1½" x 1/8" steel angles welded to back/underside of counter top/shelf. Offset angle beyond joining metal edge ½" (min.) to provide flat backing surface for joint with angle of other joining metal edge, set for ½" space between vertical legs of angles. Bolt sections together with 5/16" machine bolts, lock washers, acorn head cap nuts, set 3" o.c.
- E. Closed Base Bodies: draw-type with hairline seam fully field-welded.
- F. Millwork: plastic laminated material joints shall be doweled, glued and draw-bolted with fasteners.
- G. Solid Polymer: surfaces drawn tight, filled, sanded and finished to match adjacent surface.

2.33 PREFABRICATED COLD STORAGE ASSEMBLIES

- A. Assembly to be installed by Factory Authorized Installers only.
- B. KEC to provide a 1-year walk-in panel installation warranty. Panel installation warranty to cover labor and part replacement issues resulting from a failure to adequately complete the following during installation:

1. Walk-in panels to be installed in a square, plumb and level manner.
 2. Ceiling panels to be installed flush and tight to wall panels with the gasket material undamaged and to create a proper seal. Any signs of condensation at joints or walk-in walls should be reported to FDP and addressed immediately. Caulk at panel seams will not be an acceptable solution.
 3. All cam-locks should be engaged and button holes in place.
 4. Any gaps under floor angle (due to shimming) must be sealed completely to the slab.
 5. All penetrations in ceiling or wall panels should be insulated and sealed.
 6. Proper installation of the door systems should allow for the door to self-close and seal around the perimeter of the door opening and at the floor threshold.
 7. Final operation of the IC/IC+ control, door heaters and light switches should be confirmed upon completion of the electrical connections.
 8. Service issues, resulting from faulty installation will be covered under the walk-in panel installation warranty.
- C. KEC is responsible for overall install accuracy/quality and quality control of work performed regardless of installer or any field modifications due to building/construction conditions. KEC to provide Letter of Install Approval to FDP upon completed install verifying that all items above have been inspected by the KEC for completeness. This letter will be required as part of the completion of the contract.
- D. Sectional Assemblies: size/shape indicated on drawings; 9'-6" interior clearance unless otherwise specified. Door locations/size: exactly as shown.
- E. Sandwich Panel Insulation: Class 1 Urethane with a vapor barrier, 4" thickness (unless specified otherwise) with mature "U" factor of .030 or lower. Finished panels shall be UL-listed and demonstrate a flame spread rating of 20 or less. Panels must meet performance standards as outlined in U.S. Government legislation.
- F. Wherever compartment dimension exceeds clear-span ability of ceiling panels, provide I-beam support on exterior of ceiling or spline-hangers. Install ½" diameter steel rods through beam/hangers and secure to structure above. Beams or posts within compartments are not acceptable.
- G. Reinforce prefabricated wall panels to rigidly support the door assemblies. The perimeter of the door and frame shall be built of a fiberglass reinforced polymer (FRP) pultrusion. All pultrusions shall be non-conductive, non-corrosive, rust proof and NSF listed. All doors shall be furnished with a replaceable aluminum braided heater wire, electronically monitored, and controlled as to initiation temperature, termination temperature and percentage of operation time as required. Install 2" x 4" 16-gauge stainless steel hat-channel full-width of the jamb with 1/8" stainless steel removable flush sill, secured with stainless steel screws and sealed watertight to channel.
- H. Reinforcement as required to be provided above Freezer door (exterior) and panel next to door (handle side – interior) for mounting of Emergency Strobe Beacon, Push Button Panic Alarm and Release Knob. Emergency Strobe Beacons are by Division 26.
- I. Provide aluminum cove base at interior and exterior of exposed panels for all floor assemblies.
- J. Floor Installations:
1. **4" Recessed Exposed Factory Floor Installation (if required):**

- a. Six mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.
- b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.
- c. 4" commercial grade manufacturer's dura floor with diamond treadplate surface and marine grade plywood subfloor.
- d. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.
- e. 1/2" sand leveling bed by G.C.

2. 8-1/2" Recessed Floor Installation (if required):

- a. Six mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.
- b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.
- c. 4" manufacturer's floor.
- d. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.
- e. 1/2" sand leveling bed by G.C.
- f. Concrete flooring and tile over insulation by Divisions 03/09.

3. 12" Recessed Floor Installation (if required):

- a. Six mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.
- b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.
- c. 4" manufacturer's floor.
- d. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.
- e. 1/2" sand leveling bed by G.C.
- f. Concrete flooring over insulation by Division 03:
 - i. Concrete mix: 5000 psi @ Freezers and 3000 psi @ Coolers.
 - ii. No limestone or fly ash; fiberglass reinforced.
 - iii. #3 rebar, set on 12" centers in both directions.
 - iv. Center rebar vertically in wearing bed.
 - v. 10" high concrete 45° angled wall curb at interior perimeter per food service details.
- g. Diamond treadplate wall panels on the interior and exposed exterior by 11 40 00. Refer to drawings for height. Coordinate diamond treadplate wall covering at the interior with angled wall curb.
- h. Ventilation Pipe Requirements by G.C.:
 - i. Bottom perforated vent pipes to be #40 PVC on six ft. max centers open on both ends with the thermostatically controlled fan on (1) end and perforated mesh on the opposite end of the fan at the exterior of the building.
 - ii. Vent pipes to turn parallel with exterior wall - 180°turn down.
 - iii. Vent pipe openings to be held at 24" above grade or roof per design.
 - iv. Fans to be Grainger Manufacturer and sized per airflow needs. Airflow is to be sized based on the length and number of bends.
 - v. If no exterior wall is adjacent, vent pipes will route up and extend past the roof. Roof penetrations by Division 07.

4. Surface Mounted Factory Floor Installation (if required):

- a. 4" commercial grade manufacturer's dura floor with diamond treadplate surface and marine grade plywood subfloor.
 - b. 36" reinforced diamond treadplate internal ramp.
 - c. 10-gauge stainless steel threshold to provide a smooth transition to the interior cold storage assembly floor.
- K. Integrated, flush-mounted temperature monitor/alarm with sensor and probe-cord length required to extend from the exterior front of the assembly to a mounting position of the sensor within the evaporator return airstream. System to have an easy-to-read LCD with high and low alarm set points with audible and visual alerts for alarm conditions. System to include Adaptive Programming for automatic set point control. Wi-Fi connectivity is included for remote notifications of alarms such as power failure, high and low temperatures, entrapment, and door open. System to include a built-in panic alarm. The system is to be interconnected to the Building Automation System (BAS) or the Owner's Network (by Division 27) and to notify facility personnel of the district/owner choosing when activated.
- L. Heated and illuminated Push Button Panic Alarm with protective cover located inside Walk-In Freezer on panel next to door (handle side) – ADA mounting height. Pre-pipe conduit in panels from Panic Alarm to above the freezer door (or Cooler door if 'inline' assembly) for installation of strobes. Panic Alarm to interconnect to external Strobe Lights by Division 26 and BAS by Division 27. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsections F. Division 26 (**Electrical**) and G. Division 27 (**Communication**) for additional information.
- M. KE2 Smart Access (unless otherwise specified). Confirm all component model numbers for complete installation and operation.
- N. LED surface-mounted light fixture, in quantity/arrangement shown on drawings—light fixtures to be perpendicular to coils. Light fixtures wired to interior and exterior temperature control panel. Light fixtures are to be provided by Section 11 40 00 and installed by Division 26. Division 26 is to seal all conduit penetrations at light fixtures. KEC to verify that penetrations are sealed.
- O. Penetrations of Panels: To be sealed by factory installer and appropriate trade contractors, with Dow Corning 3-6548 silicone RTV foam, total depth of the panel. Trim excess flush. KEC to verify that all penetrations are sealed.
- P. Install closure panels and trim strips to building walls and ceiling with concealed attachment. Closure material: same as wall panels unless noted otherwise.
- Q. Compartment Entrance Doors: 36" x 78" nominal clearance unless otherwise noted.
1. Mount hinged doors on two Kason Model No. 1346; polished chrome-plated nylon cam-lift hinges.
 2. Hinge doors as indicated on drawings.
 3. Defrost heater: Thermostatically controlled and replaceable at the entire perimeter of all doors, except when using clear Lexan doors (in addition to door jambs). Defrost heaters to be wired for continuous service.
 4. 36" high x full-length diamond aluminum treadplate at front and rear of all hinged doors.
 5. 12" x 2" engraved phenolic plastic compartment identification sign in Architect's color selection with 1" letters, mounted above door window.

6. 14" x 24" four-panel glass view window with heater and molded non-metallic inner and outer frame. The heater is to be wired and controlled via the door monitor for continuous service.
 7. Padlock/key provisions in the door latch with safety release mechanisms as listed below.
 8. Kason 1826 Intelli-Vent LED Heated Pressure Relief Ports with Dual Port Vent and Security Light. Locate One (1) 12" below ceiling on Cooler/Freezer common wall panel and One (1) 12" below ceiling on Cooler wall panel. If Cooler and Freezer are separate units, locate one on the Freezer wall panel as well, 12" below ceiling and mounted in the door frame assembly. All ports to have separate dedicated electrical connections and be wired for continuous service. Located and installed by Manufacturer.
 9. Kason Model No. 0487 (unless specified otherwise) Frost Free inside release with fiberglass rod and plastic flange with safety flow plastic knob – ADA compliant.
 10. Manual backup vacuum release mechanism to punch hole in Freezer door panel assembly to release vacuum within Freezer assembly. Mechanism to include a pull-down handle with freeze- proof hand grip. Handle to have the ability to penetrate and/or punch hole in panel accordingly to assist with opening of door in the event of entrapment (and failure of frost-free inside release button). Door panel to include knock-out section to assist with requirements. Release mechanism assembly to be built-in/mounted to the door assembly structural frame to minimize mechanism tear-out and/or failure. Handle to be painted yellow with phenolic label "Vacuum Pressure Release."
- R. Provide refrigeration calculations and refrigeration alarm to meet local jurisdiction code requirements.
- S. If air screens or air shields are specified above doors or on the interior of the assembly, the manufacturer must provide adequate blocking in panels to support these components and pre-wired electrical connections. Installer to coordinate location of door closure to not interfere with air screens or air shields. Clear-VU swinging door assemblies are not required if air shields are specified.
- T. S/S trim above cold storage assembly to conceal manufacturers ceiling grid.
- U. Field-check all horizontal/vertical measurements and conditions at the building before fabrication or delivery of equipment.
- V. Cold Storage Assemblies to be installed by Manufacturer pre-approved installers.
- W. Installer to seal all holes in Cold Storage Assembly.

2.34 COLD STORAGE REFRIGERATION SYSTEMS

- A. Unit Coolers: specified quantity and model, ceiling-hung by ½" o.d. nylon bolts with stainless steel washers and nuts. Insert hanger bolts through plastic sleeve and seal penetration airtight.
1. Unit cooler drain fittings: positioned as indicated on drawings. Installation of cast tee-fittings on drain pan outlet with union and cleanout plug and extension of 1" Type K copper drain line through wall panel to air-gap fitting or floor drain under this Section.
 2. Slope drain line ½" per foot, trap at exterior of assembly and turn down into drain. Manifold drain lines of adjacent compartments wherever possible.

3. Install drain line plastic sleeve through compartment wall, seal around drain line and install stainless steel escutcheon with setscrews.
4. Electric drain line heater cable (self-regulating 7 watts): on all unit coolers operating below 36oF., installed from coil drain line fitting to wall penetration under this Section. Heater cables: minimum rating of 15 watts/lineal foot, 208 volts, single phase. Wrap drain line with maximum 2" loop spacing and interwire to unit cooler for continuous operation.
5. Mounted, pre-piped and pre-wired evaporator components:
 - a. Sporlan thermostatic expansion valve with external equalizer.
 - b. Shut-off valve at evaporator suction and liquid lines.
 - c. Sporlan "Catch-All" refrigerant filter/dehydrator on liquid line.
 - d. White Rogers 1609-101 adjustable thermostat with remote bulb positioned in return air-stream of evaporator.
 - e. Electrical disconnect switch in NEMA 4 enclosure.
 - f. **For any facility within 20 miles of a salt air environment:** Condenser and Evaporators to be built with Electrofin coating to retard salt air deterioration. Coils are to be coated with Technicoat 10-2 coating for protection against a salt air environment.

B. Refrigerant System Installation.

1. Refrigerant Lines; Type "L" hard copper tubing. Fittings: wrought copper or brass designed for use with high temperature solder. Piping joints: made with silver solder (Sil-Fos). Piping: properly suspended from and anchored to the structure with adjustable hangers 6' o.c. maximum. Suction lines: sized to have maximum pressure drop of two pounds in medium temperature systems; one pound in low temperature system. Liquid lines: sized to give maximum pressure to prevent trapping of oil. Insulation on all suction lines: Armaflex insulation by Armstrong. ¾" thick at medium temp 1" thick at low-temp. Refrigerant lines in PVC or EMT conduit: sealed at both ends with Dow Corning 3-6548 silicone RTV foam. Exterior Refrigerant Lines to be wrapped by refrigeration system installer in self-fastening jacket of Type 3003-H14 aluminum alloy 0.016-inch thick. Provide aluminum strapping and seals for applying aluminum jacket and covers according to manufacturer's recommendations to provide completely weather-tight covering.

C. Evacuation and Charging.

1. After completion of the pressure test, the system shall be evacuated using an approved auxiliary vacuum pump. Connections for evacuation: in accordance with manufacturer's recommendations.
2. Charging subsequent to the initial charge, which is contained in the condensing unit (Type of Refrigerant to meet District Standards, Industry Standards and Codes.) - Non- CFC Ozone Depletion Refrigerant on low temp units) – (Refrigerant must meet local codes): given through the charging valve in the high side passing all of the liquid refrigerant through a charging dehydrator. All charging lines and gauges: purged of air prior to connection with system. Refrigerant: unused and shall be delivered in clean containers. After the system is fully charged: start and place in full operation.

2.35 PRE-APPROVED KITCHEN SUPPLIERS

- A. Only the following named Subcontractors and those approved later, if any, are approved for inclusion in the Contractor's Bid.
- B. **Any supplier requesting for inclusion within this bid will be required to submit AIA form 305 minimum 14 days prior to bid date for review, or as required by Architect.**

1. Ed Don & Company, Mr. Scott Jost, 3501 Plano Parkway, The Colony, Texas 75056, Phone: (972) 624-7460, Fax: (972) 624-7762, E-mail: scottjost@don.com
2. Kirby Restaurant Supply, Mr. Brian Kernan, 809 S. Eastman Road, Longview, Texas 75602, Phone: (903) 757-2723, Fax: (903) 757-9519, Email: briank@kirbyrestaurantsup.com
3. Oswalt Restaurant Supply, Mrs. Lindsay Reece, 4532 Enterprise Dr, Oklahoma City, OK 73128, Phone: (405) 843-9000, Email: lindsay.reece@oswalt.biz
4. Supreme Fixture Co. Inc., Mr. Tim Hampel, 11900 Vinny Ridge Road, P.O. Box 193655 Little Rock, Arkansas 72219, Phone (501) 455-2552, Fax: (501) 455-0802, Email: tim@supremefixture.com

PART 3 - EXECUTION

3.1 DELIVERY AND INSTALLATION

- A. Supervision: provide a competent foreman or supervisor who shall remain on the job during the entire installation.
- B. Delivery: coordinate with progress of construction and Owner's operation schedules. Unless otherwise instructed and documented by Owner or General Contractor, the following procedures apply:
 1. Field-Assembled Fixed Equipment integrated into the structure (e.g., cold storage assemblies, exhaust hoods, drain trench/grate assemblies, conveyor systems, ceiling-mounted utensil racks, etc.) are to be sent to the jobsite when directed by the General Contractor and installed/protected accordingly.
 2. All other Fixed Equipment: delivered after completion of work on adjacent finished ceilings, lighting, finished floor and wall systems, including painting.
 3. Major Movable Equipment: delivered when possible to inventory in secured area for interim job-site storage or, if secured area is not available, when fixed equipment installation/clean-up has been completed.
 4. Minor appliances and loose items (e.g., pans, covers, flatware containers, etc.) delivered only when Owner is prepared to receive and inventory such items.
- C. Installation: performed by manufacturer of custom fabricated fixtures.
 1. Assemble, square, level and make ready all items for the final utility's connections.
 2. Cut neatly around obstructions to provide sanitary conditions.
 3. Where gaps of ¼" or less occur adjacent to or between equipment, insert rope backing and smoothly-applied General Electric construction sealant Series SE-1200 silicone mastic (white color). Mask both sides of gap for neat application of sealant and remove excess. If space exceeds ¼", neatly install 18-gauge stainless steel trim molding of proper shape with concealed attachment. Use epoxy cement or "Z" clips wherever possible to secure stainless steel trim. Exposed edges or corners of trim: eased and smooth.
 4. Refrigeration coil drain line runs to indirect drain connection greater than 2" from face of wall or panel: either of the following field procedures.
 - a. Trench the floor and provide 6" wide x 2" deep 16-gauge stainless steel sloping (-1" to -2") trough from face of cooler/freezer wall to body of floor sink/floor drain. Trough: turned up 4" at wall; ¾" flange with ½" turndown at both long sides. Set trough in waterproof mastic and seal 1" o.d. drain tube penetration into floor sink/floor drain at -2½" bff. Patch the floor to match adjacent material/surface.
 - b. Provide 12" x 6" x 2" deep 16-gauge stainless steel condensate pan mounted to cooler/freezer wall at 6" aff clear. Trench the floor and install 1" o.d. drain line from

bottom of pan to body of floor sink/drain. Slope drain line ¼" per foot and seal all connections watertight. Patch the floor to match adjacent material/surface.

D. Protection of Work:

1. Fabricated fixtures: fiberboard or plywood taped to tops and exposed body panels/components.
2. Manufactured Equipment: fiberboard or plywood taped as required by equipment shape and installation-access requirements.
3. Prohibited use of equipment: tool and materials storage, workbench, scaffold, stacking area, etc.
4. Damaged Equipment: immediately documented and submitted to Owner with Contractor's recommendation of action for repair or replacement and its impact on the Project Schedule and Contract Amount, if any.

3.2 CLEAN AND ADJUST

- A. Clean up and remove from the job site, all debris resulting from this Work as the installation progresses.
- B. Thoroughly clean and polish interior/exterior of all Foodservice Equipment, prior to demonstration and final observation, ready for Owner's use.
- C. Lubricate and adjust drawer slides, hinges, casters.
- D. Adjust pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, exhaust hood grilles, etc.
- E. Clean or replace faucet aerators, line strainers.
- F. Touch-up damage to painted finishes.
- G. G. Start up and check operation of all refrigeration systems for at least 72 hours prior to acceptance.

3.3 EQUIPMENT START-UP/DEMONSTRATION

- A. Carefully test, adjust and regulate all equipment in accordance with the manufacturer's instructions and certify in writing to the Owner that the installation, adjustments and performance are in full compliance.
- B. Provide the Owner or Foodservice Operators with a thorough operational demonstration of all equipment and furnish instructions for general and specific care and maintenance. Coordinate and schedule selected items of equipment and attendees with Owner at least two weeks in advance of demonstration periods.

3.4 FINAL OBSERVATION

- A. Final observation will be made when the Contractor will certify that he has completed his work, made a thorough review of the installation/operation of each item in the contract and found it to be in compliance with the Construction Documents.
- B. Repetitive final observations (more than two) and all costs associated thereto which may be incurred due to the Contractor's failure to comply with the requirements of this Article will be invoiced to this Contractor on a \$70.00/hr. and expense basis.

PART 4 - EQUIPMENT SCHEDULE

- 4.1 REGULARLY-MANUFACTURED EQUIPMENT/COMPONENTS:** Standard finishes and accessories unless specifically deleted or superseded by the Contract Documents.
- 4.2 FABRICATED AND FIELD-ASSEMBLED EQUIPMENT:** Arrangement and configuration as shown on Plans, Elevations, Detail Drawings and outlined in Specifications.
- 4.3 REFER TO DRAWINGS:** For unit quantities and electrical or mechanical provisions required, including manufacturer's optional voltages, wattages, burner capacities, etc.
- 4.4 REFER TO PART 2 – PRODUCTS:** For accessories, fittings, requirements and procedures related to the listed buy-out and fabricated equipment.
- 4.5 ALTERNATE MANUFACTURER REQUIREMENTS:** A specific product manufactured by the listed pre-approved equals shown under Section 4.7 Foodservice Equipment are acceptable only if the specific product can evidence compliance with the specified line items and the contract documents.
- 4.6 RE-USED EXISTING EQUIPMENT IF SHOWN**
- A. Existing equipment scheduled for re-use is to be inventoried and documented that equipment is in operating condition once Kitchen Contractor has taken ownership.
 - B. Provide pictures of all equipment once inventoried and issue to the architect to ensure that equipment has not been damaged.
 - C. Verify locations of all equipment with owner.
 - D. Existing equipment that is to be reused may be missing parts or accessories for proper and complete operation. Submit report listing all items with pricing for approval to allow complete installation.
 - E. Utility disconnection and re-connection: under Divisions 22 and 26. Kitchen Contractor to verify utility requirements of existing equipment and coordinate with Kitchen Consultant as required. All utilities not scheduled for re-use to be capped and covered by required disciplines.
 - F. Disassembly, removal, transportation and relocation: under this Section and scheduled with General Contractor. Owner's representative must be present, coordinate date / time with owner.
 - G. Thoroughly clean inside and out prior to relocation.
 - H. Review functional parts (e.g., doors, controls, heating elements, compressors, etc.) and submit report of required repairs and estimate of cost. Any finishes or equipment damaged due to construction to be repaired as required.
 - I. Existing equipment not scheduled for reuse is to be carefully removed/relocated by the Kitchen Contractor per the Owner's direction. Kitchen Contractor to coordinate date / time with General Contractor and Owner.
 - J. Removal or replacement of existing equipment is to be scheduled for times of least interruption and inconvenience to the foodservice operation. Submit proposed schedule of time frame, task sequence and operation for approval prior to starting work.

- K. Kitchen Contractor to verify size and shape for all existing equipment being re-used and coordinate with Foodservice Consultant as required.
- L. Any modification(s) required/desired for re-used existing equipment to be verified by the Kitchen Contractor. All modifications must be approved by the Owner and Foodservice Consultant prior to the modifications being made.
- M. The KEC is to verify and coordinate all of the utility requirements with the construction documents as required. Refer to the general specifications re: conflicts.

4.7 FOODSERVICE EQUIPMENT

- A. All equipment to have a performance check from factory authorized personnel. Warranties will begin on the day of performance check.
- B. All equipment and internal components should be of domestic origin where possible.
- C. Architectural coordination items for potential Food Service color or material selections.
 - 1. Countertops: Stone (stainless steel is provided unless otherwise specified)
 - 2. Tray slides: Corian or Stone (stainless steel is provided unless otherwise specified)
 - 3. Counter fronts: Ceramic tile, 3 Form, Plastic Laminate
 - 4. Sneeze Guards: Stone insets.
 - 5. General color/graphic selections:
 - a. Display Air Screen Merchandisers - Color selection: Powder coat or Plastic Laminate (stainless steel is provided unless otherwise specified)
 - b. Bakery Display Cases - Color selection: Powder coat or Plastic Laminate (stainless steel is provided unless otherwise specified)
 - c. Pass Thru or Reach-in Holding Cabinets – Color selection: Powder coat (Mfg: True) or Plastic Laminate (Mfg: Traulsen). (Stainless steel is provided unless otherwise specified).
 - d. Hanging Heat Lamps, track and fixture colors.
 - e. Heated Merchandisers
 - f. Color of Portable Guide rails, stanchions and belt
 - g. Popcorn machine: signage
 - h. Bottle Cooler: signage
 - i. Graphic package information
 - j. Hot food well covers
- D. General Architectural finishes:
 - 1. Walls: Ceramic Tile, Flat FRP, Molded FRP, (as approved by local jurisdiction).
 - 2. Ceilings: Removable Vinyl Face Tile (easily cleanable as approved by local jurisdiction).
 - 3. Floors – Tile, Epoxy, Rubberized flooring system (coordinate floor tile transition at serving lines)
 - 4. Floors – Cold Storage assembly. Extend kitchen floor flush into walk-in assembly with coved base.
 - 6. Furr downs above Serving Counters

MAIN KITCHEN

ITEM NO. 101 AIR SCREEN

QUANTITY 1

Manufacturer: Berner
Model: CHD10-2072A
Size and Shape: Refer to drawings
Alternate:

1. Air curtain, CHD series model, unheated, obsidian black exterior. Size unit to fit door.
2. Air Curtain to include Controller Kit. Controller kit to come complete with plastic magnetic reed switch, surface mounted, .50 HP max, 115v/1-ph limit switch. The magnet to be mounted on the surface of the door jamb and the door.
3. Provide One (1) additional micro switch for additional door.
4. Confirm clearance above door prior to installation. Air Curtain to accommodate door width and height.
5. 114000 to provide magnetic reed switch kit loose to General Contractor for installation by Division 26. Division 26 to route flexible conduit to j-box on cabinet. Routing to be clean and secured to building.
6. Provide Harsh Weather Cover if no awning or recessed door is provided.

ITEM NO. 102 COLD STORAGE ASSEMBLY

QUANTITY 1

Manufacturer: American Panel
Model: ---
Size and Shape: Refer to drawings
Alternate: Thermokool, Kolpak

1. Installation to be completed by Jack Horton
2. Manufacturer to review final installation and provide a letter confirming installation meets manufacturer requirements.
3. Assembly to have 9'-6" interior clearance.
4. 304 #3 finish 20 gauge stainless steel finish where exposed, 20 gauge galvanized steel where concealed.
5. Factory floor with smooth aluminum finish, recessed in slab 8 1/2". Secure floor to wall assembly with cam-lock assembly. KEC to ensure the floor assembly is level prior to the wearing bed installation. Kitchens finished floor to extend to walk-in.
6. Threshold to be smooth and level with finished floor. - Critical.
7. Interior walls to be .040" aluminum, white embossed texture on walls.
8. Ceiling to be embossed textured .040" aluminum baked white enamel.
9. Two (2) 36" doors. Doors to be 18-gauge stainless steel, type 304 (18-8), #3 finish, with heated perimeter / door jambs / windows and threshold heaters. Each door to be equipped with 3'-0" high diamond tread kick plate on both sides of doors. Mount hinged doors on two (2) Kason model no. 1346 (or equal); polished chrome plated nylon cam-lift hinges.

10. Provide heated illuminated Push Button Panic Alarm with protective cover and Phenolic Label "PANIC ALARM" for entrapment within Freezer (ADA mounting height). Panic Alarm Encasing is to be stainless steel (not plastic). Manufacturer to pre-run conduit within panel from Panic Alarm to panel above Freezer door (or Cooler door if 'inline' assembly) for installation of Emergency Strobe/Horn. Division 26 will provide (2) external Emergency Strobe/Horn Beacons and interconnect the Push Button Panic Alarm to external Beacons (One above the Freezer door and One in the Cafetorium). Division 27 will interconnect the Push Button Panic Alarm to the Building Automation System for Owner notification. ----PM to advise the AE team early on of these requirements to ensure Division 26/27 know what is required and coordinate as needed.
11. Reinforcement as required to be provided above Freezer door (exterior) and panel next to door (handle side - interior) for mounting of Emergency Strobe Beacon, Push Button Panic Alarm and Release Knob.
12. The Cooler will have the standard control panel with standard panic button tied into the Owner's network for notification.
13. Provide standard door handle, with key and padlock option. Include internal emergency release.
14. 18-gauge stainless steel, type 304 (18-8), #3 finish trim where adjacent to walls and enclosure panels that extend to 2" above finished ceiling.
15. Freezer One (1) lot LED light fixtures to operate in temperatures to -20 F. Lights to be installed perpendicular to coils.
16. Refrigerator- One (1) lot LED light fixtures. Lights to be installed perpendicular to coils.
17. 3'-0" high diamond tread plate at exposed exterior surfaces. Fasten to wall with stainless steel fasteners.
18. Provide door bumper at doors.
19. Compartments to have all electrical concealed within the walls or located above the ceiling.
20. Provide Manufacturers alarm/control system that includes hi/low limits . Route temperature sensor to be located to the side of evaporator coil.
21. Doors to be provided with CCI Industries, Inc., Clear-VU swinging door assemblies, Alternate: Kason.
22. K.E.C. to provide aluminum coved base to interior of assembly. Provide sealant between floor and wall panels.
23. All holes in assembly to be sealed by factory installer.
24. Kason 1826 Intelli-Vent LED Heated Pressure Relief Ports with Dual Port Vent and Security Light. Locate One (1) 12" below ceiling on cooler/freezer common wall panel and One (1) 12" below ceiling on exterior cooler wall. All ports to have separate dedicated electrical circuits. Pressure relief ports to be wired for continuous service. Relief port to be located and installed by Walk-in Manufacturer.
25. KEC to field verify all horizontal/vertical measurements and conditions at the building prior to fabrication or delivery of equipment.
26. KEC to provide 1-year walk-in panel installation warranty. KEC is responsible for overall install accuracy/quality and quality control of work performed regardless of installer or

any field modifications due to building/construction conditions. KEC to provide Letter of Install Approval to FDP upon completed install.

27. Manufacturer to provide One Year Parts and Labor Warranty.
28. Interwiring of temperature monitor panel to master building alarm system or to the Owner's network. Technology department to provide all interfacing of alarm system and with the building alarm system. Conduit from refrigeration system to monitor by Division 26. Temperature Monitor installation at 4'-0" above finished floor. All conduit to be located above walk-in cooler/freezer ceiling. Exposed electrical conduit is not acceptable.
29. Manufacturer Representative to provide training on controls and inside emergency release mechanisms.

ITEM NO. 103.1 REFRIGERATION SYSTEM

QUANTITY 1

Manufacturer: Heatcraft
Model: Custom
Size and Shape: Refer to drawings
Alternate:

1. Indoor Air cooled system.
2. To included 100% redundancy
3. Scroll Compressors.
4. Cooler temperature to be +35 degrees.
5. Freezer temperature to be -10 degrees.
6. EcoSmart system on demand defrost.
7. KE2 Evap Controllers located per Owner requirements.
8. S/S covered housing.
9. A dedicated electrical connection to be provided for heated condensate drain line. Refer to electrical plan for location.
10. All exterior piping to be aluminum wrapped.
11. System to accommodate Item No. 102 Cold Storage Assembly.
12. System to be located In Mechanical room. Coordinate location with architectural plans. Coordinate mounting requirements with appropriate trades.
13. Refrigeration rack accommodates 110 ambient temperatures.
14. Mount condensing unit on common exterior rack. Refer to Architectural and Engineering drawings for exact location of remote unit. Coordinate routing of refrigeration lines and conduit with appropriate trades. Heat tape and insulate all drain lines. General Contractor to seal all building penetrations at refrigeration lines.
15. Warranty to start at Substantial Completion date.

ITEM NO. 104 COLD STORAGE SHELVING

QUANTITY 2

Manufacturer: Owner Furnished
Model:

Size and Shape: Refer to drawings
Alternate:

ITEM NO. 105 DUNNAGE RACK

QUANTITY 4

Manufacturer: Owner Furnished
Model:
Size and Shape: Refer to drawings
Alternate:

ITEM NO. 107 DRY STORAGE SHELVING

QUANTITY 2

Manufacturer: Owner Furnished
Model:
Size and Shape: Refer to drawings
Alternate:

ITEM NO. 108 CAN RACK

QUANTITY 1

Manufacturer: Owner Furnished
Model:
Size and Shape: Refer to drawings
Alternate:

ITEM NO. 109.2 ICE MACHINE

QUANTITY 1

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. GC to disconnect/reconnect all utilities as required.
6. Provide sizes and quantities as required: T&S model #HW-6VERIFY-48 water hose and disconnect from filter to steamer, color coded for filtered and non-filtered water.
Alternate: Dormont

ITEM NO. 111 CHEMICAL SHELF

QUANTITY 2

Manufacturer: Owner Furnished
Model:
Size and Shape: Refer to drawings

Alternate:

ITEM NO. 126 BACK COUNTER

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14 gauge type 304 S/S, 2" turn down at free sides, 10" high splash on rear or adjacent equipment/walls.
2. Open base construction.
3. 16 gauge S/S undershelf.
4. One (1) 15" x 18" x 10" deep sink compartment. Coordinate location with drain overflow.
5. One (1) T&S model no. B-0320-BB-CR , rigid gooseneck, ceramic cartridges, deck faucet for ¾" hot and cold water connections.
6. One (1) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece
7. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
8. Omit rear crossrail at sink section.
9. Flanged feet at front legs.

ITEM NO. 135 60 QUART MIXER

QUANTITY 2

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.

ITEM NO. 138 PAN RACK

QUANTITY 18

Manufacturer: Owner Furnished
Model:
Size and Shape: Refer to drawings
Alternate:

ITEM NO. 144 WORKTABLE W/DBL.BAR UT.RACK

QUANTITY 4

Manufacturer: Custom Fabricated
Model: ---

Size and Shape: Refer to drawings
Alternate: Aero, Eagle

1. Top: 14 gauge type 304 S/S, 2" turn down at all sides.
2. Open base construction.
3. Full length 16 gauge S/S undershelf.
4. Flanged feet.
5. Vertical utility post at both ends of table to accommodate electrical DCO.

ITEM NO. 151 FIRE PROTECTION SYSTEM

QUANTITY 4

Manufacturer: Ansul
Model: R102
Size and Shape: Refer to drawings
Alternate: ---

1. Duct and plenum protection to exhaust hood.
2. Surface protection for cooking equipment.
3. Locate remote fire pulls as recommended by Fire Marshal.
4. One (1) lot Mechanical gas valve (maximum diameter as required). Size as required. Furnished by Section 114000, installed by Division 22. Kitchen Equipment Contractor to coordinate location with local Fire Marshal requirements prior to submittal review. All conduits to be recessed within wall, SURFACE MOUNTING WILL NOT BE ACCEPTED.
5. System to meet U.L. 300 requirements.
6. Provide one (1) hand held Type 'K' and ABC 6 liter fire extinguisher per Ansul System, surface wall mounted.
7. Exposed pipe threads are unacceptable.
8. All exposed piping to be chrome plated.
9. All hood penetrations to have U.L. listed "Quick Seal". Provide s/s escutcheons at all hood penetrations.
10. Provide phenolic I.D. labels for exhaust hood, remote fire pull, light/fan switches and fire protection system.
11. Provide a manufacturer performance test and report that verifies this system is fully operational.
12. Provide s/s cabinet as shown on plan.
13. Installer to provide one (1) Ansul system per exhaust hood, review drawings and provide systems as required.
14. Install hand held extinguishers, maximum of 3'-2" A.F.F. to top of unit.

ITEM NO. 152 EXHAUST HOOD

QUANTITY 1

Manufacturer: Mod-U-Serve
Model: W-cpb
Size and Shape: Refer to drawings

Alternate: ---

1. Size and shape as per plan.
2. Supply Air. Ceiling mounted supply plenum with light fixtures, coordinate conditioned/tempered air with engineer. Locate supply plenum in ceiling, coordinate location with GC as required.
3. U.L. Listed and fire rated 48" recessed LED lights located within the hood canopy. To meet minimum requirements of 50' candles of illumination.
4. Simple on/off switches for hood fans and lights to be provided by Division 26. Control panels will not be accepted.
5. Hood to meet requirements of ALL local Mechanical and local Energy Codes.
6. Collars to be field installed. Coordinate with existing conditions and install as approved by Hood manufacturer.
7. All 18 gauge S/S construction. S/S finish where exposed.
8. For extended cooking line-ups provide Continuous Capture canopies without partitions between hoods.
9. Provide Dormont safety set wheel positioning system for all mobile production equipment under the hood.
10. Hood to have insulated front face and ends to allow for ceiling grid attachment where ceiling grid meets hood capture area.
11. S/S filters and grease cup. Provide filter removal tool.
12. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
13. All hood penetration to be fire rated and U.L. Listed and sealed with s/s escutcheons.
14. S/S c-channel closure panel from top of hood to ceiling.
15. S/S filler panel between hoods if back-to-back.
16. 4" air space at rear of hood. Provide S/S finished back where rear air space would otherwise be exposed.
17. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
18. Clearance requirement: Where any exterior surface of a hood is installed less than 18" from a combustible or semi-combustible surface, provide a minimum of 4" air space containing a code approved fire resistant material to that surface in a manner as prescribed by the manufacturer of that fire-resistant material. Protective materials provided by 3M Fire Barrier Duct Wrap 615+ and Fry Ware Elite are compliant with state and local mechanical codes. In addition, both systems meet the requirements of the testing standards of ASTM E2336 AND ARE THEREFORE APPROVED TO BE USED IN CLEARANCE REDUCTION APPLICATIONS.
19. Provide Mod-U-Serve model number ASTS-90 pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 110 degrees F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 110 degrees F.

20. Provide minimum 18-gauge stainless steel insulated wall panel 5/8" pan formed, filled with USDA Approved insulation. Extend from top of cove base to underside of hood.
21. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.
22. Mechanical contractor to test and balance exhaust hoods. Balance report to be provided to FDP upon completion.
23. Special Instruction: Refer to individual hood and plenum box lengths as shown on drawings for each assembly required. Install bottom of hood at 6'-10" A.F.F. Install plenum boxes recessed and interconnect to wall mounted light switch by Division 26.

ITEM NO. 153 EXHAUST HOOD

QUANTITY 1

Manufacturer: Mod-U-Serve
Model: W-cpb
Size and Shape: Refer to drawings
Alternate: ---

1. Size and shape as per plan.
2. Supply Air. Ceiling mounted supply plenum with light fixtures, coordinate conditioned/tempered air with engineer. Locate supply plenum in ceiling, coordinate location with GC as required.
3. U.L. Listed and fire rated 48" recessed LED lights located within the hood canopy. To meet minimum requirements of 50' candles of illumination.
4. Simple on/off switches for hood fans and lights to be provided by Division 26. Control panels will not be accepted.
5. Hood to meet requirements of ALL local Mechanical and local Energy Codes.
6. Collars to be field installed. Coordinate with existing conditions and install as approved by Hood manufacturer.
7. All 18 gauge S/S construction. S/S finish where exposed.
8. For extended cooking line-ups provide Continuous Capture canopies without partitions between hoods.
9. Provide Dormont safety set wheel positioning system for all mobile production equipment under the hood.
10. Hood to have insulated front face and ends to allow for ceiling grid attachment where ceiling grid meets hood capture area.
11. S/S filters and grease cup. Provide filter removal tool.
12. 1/2" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
13. All hood penetration to be fire rated and U.L. Listed and sealed with s/s escutcheons.
14. S/S c-channel closure panel from top of hood to ceiling.
15. S/S filler panel between hoods if back-to-back.

16. 4" air space at rear of hood. Provide S/S finished back where rear air space would otherwise be exposed.
17. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
18. Clearance requirement: Where any exterior surface of a hood is installed less than 18" from a combustible or semi-combustible surface, provide a minimum of 4" air space containing a code approved fire resistant material to that surface in a manner as prescribed by the manufacturer of that fire-resistant material. Protective materials provided by 3M Fire Barrier Duct Wrap 615+ and Fry Ware Elite are compliant with state and local mechanical codes. In addition, both systems meet the requirements of the testing standards of ASTM E2336 AND ARE THEREFORE APPROVED TO BE USED IN CLEARANCE REDUCTION APPLICATIONS.
19. Provide Mod-U-Serve model number ASTS-90 pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 110 degrees F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 110 degrees F.
20. Provide minimum 18-gauge stainless steel insulated wall panel 5/8" pan formed, filled with USDA Approved insulation. Extend from top of cove base to underside of hood.
21. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.
22. Mechanical contractor to test and balance exhaust hoods. Balance report to be provided to FDP upon completion.
23. Special Instruction: Refer to individual hood and plenum box lengths as shown on drawings for each assembly required. Install bottom of hood at 6'-10" A.F.F. Install plenum boxes recessed and interconnect to wall mounted light switch by Division 26.

ITEM NO. 154 EXHAUST HOOD

QUANTITY 1

Manufacturer:	Mod-U-Serve
Model:	W
Size and Shape:	Refer to drawings
Alternate:	---

1. Size and shape as per plan.
2. Exhaust only canopy (W).
3. U.L. Listed and fire rated 48" recessed LED lights located within the hood canopy. To meet minimum requirements of 50' candles of illumination.
4. Simple on/off switches for hood fans and lights to be provided by Division 26. Control panels will not be accepted.
5. Hood to meet requirements of ALL current local Mechanical and local Energy Codes.
6. Collars to be field installed. Coordinate with existing conditions and install as approved by Hood manufacturer.

7. All 18 gauge S/S construction. S/S finish where exposed.
8. For extended cooking line-ups provide Continuous Capture canopies without partitions between hoods.
9. Hood to have insulated front face and ends to allow for ceiling grid attachment where ceiling grid meets hood capture area.
10. S/S filters and grease cup. Provide filter removal tool.
11. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
12. All hood penetration to be fire rated and U.L. Listed and sealed with s/s escutcheons.
13. S/S c-channel closure panel from top of hood to ceiling.
14. S/S filler panel between hoods if back-to-back.
15. 4" air space at rear of hood. Provide S/S finished back where rear air space would otherwise be exposed.
16. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
17. Clearance requirement: Where any exterior surface of a hood is installed less than 18" from a combustible or semi-combustible surface, provide a minimum of 4" air space containing a code approved fire resistant material to that surface in a manner as prescribed by the manufacturer of that fire-resistant material. Protective materials provided by 3M Fire Barrier Duct Wrap 615+ and Fry Ware Elite are compliant with state and local mechanical codes. In addition, both systems meet the requirements of the testing standards of ASTM E2336 AND ARE THEREFORE APPROVED TO BE USED IN CLEARANCE REDUCTION APPLICATIONS.
18. Provide Mod-U-Serve model number ASTS-90 pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 110 degrees F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 110 degrees F.
19. Provide minimum 18-gauge stainless steel insulated wall panel 5/8" pan formed, filled with USDA Approved insulation. Extend from top of cove base to underside of hood.
20. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.
21. Mechanical contractor to test and balance exhaust hoods. Balance report to be provided to FDP upon completion.
22. Special Instruction: Refer to individual hood and plenum box lengths as shown on drawings for each assembly required. Install bottom of hood at 6'-10" A.F.F. Install plenum boxes recessed and interconnect to wall mounted light switch by Division 26.

ITEM NO. 158 ISLAND EXHAUST HOOD

QUANTITY 1

Manufacturer: Mod-U-Serve
Model: W
Size and Shape: Refer to drawings
Alternate: ---

1. Hood to meet requirements of ALL current local Mechanical and local Energy Codes.
2. V Banked filter bank exhaust hood.
3. All 18 gauge S/S construction.
4. Insulated hood end panels.
5. Hood manufacturer to perform hood balance reports, to be sent directly to FDP prior to final project completion.
6. Continuous capture.
7. Exhaust Only
8. Recess mounted LED light fixtures on both sides of the filter bank. All exposed fire control piping to be chrome plated and all hood penetrations sealed with S/S escutcheons.
9. Provide Dormont safety set wheel positioning system for all mobile production equipment under the hood.
10. S/S filters and grease cup. Provide filter removal tool.
11. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
12. Ventilators to have adjustable make-up air damper which must remain accessible for adjustment
13. S/S filters and grease cup with filter removal tool.
14. S/S c-channel closure panel from top of hood to ceiling.
15. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
16. Provide pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 110° F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 110° F.
17. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.
18. Provide simple on/off switches for hood fans and lights. Control panels will not be accepted.

ITEM NO. 159 CONDENSATE HOOD

QUANTITY 1

Manufacturer: Mod-U-Serve
Model: CH
Size and Shape: Refer to drawings

Alternate: ---

1. Refer to drawings for size and location.
2. Ventilator shall be manufactured with a full perimeter gutter with drain extended to floor sink. General Contractor to extend drain to floor sink.
3. Stainless steel enclosures to ceiling at all open sides.
4. Coordinate dish machine doors with condensate hood.
5. Entire system to be in compliance with NFPA pamphlet #96 and local governing code authorities, and shall be in accordance with Division 23. Shall be U.L. listed.
6. Manufacturer to check out system after installation to verify actual exhaust and supply air quantities and certify that performance is as designed and provide written report.
7. 1/2" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
8. Start up and performance check to be provided by Manufacturer Service Agency. Manufacturer warranty to start on this date.

ITEM NO. 161 CONVECTION OVEN- GAS DBL

QUANTITY 2

Manufacturer: Blodgett
Model: DFG-200 DBL
Size and Shape: Refer to drawings
Alternate: Vulcan

1. S/S front, top and sides.
2. Two (2) 1/2 HP 2-speed motors.
3. Natural gas.
4. SSI-M solid state infinite control with manual timer.
5. Electronic spark ignition.
6. Five (5) oven racks per compartment.
7. Dual pane thermal windows.
8. Simultaneous door operation.
9. Heavy duty casters, two (2) with brakes.
10. Provide quantities and sizes required: Dormont Model #VER-KITCF-2S-48" Gas Conn. Kit, 48" long, dble. Supr-Swivel coupling with SafetyQuick safety fitting, w/coiled restraining device, full port gas valve, antimicrobial coating, lifetime warranty.
11. Dedicated gas connections, do not manifold.
12. Shunt trip breaker by Division 26.

ITEM NO. 162 CONVECTION STEAMER

QUANTITY 1

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings

Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.
6. Provide quantities and sizes required: T&S Model #HG-4VERIFY-48SK Antimicrobial Coated Hose w/NPT Male Ends, Swivel Links, 2-Piece Quick Disconnect, 90° Elbow & Installation Kit w/coiled restraining device, full port gas valve, lifetime warranty. Alternate: Dormont
7. Provide sizes and quantities as required: T&S model #HW-6VERIFY-48 water hose and disconnect from filter to steamer, color coded for filtered and non-filtered water. Alternate: Dormont

ITEM NO. 164 40 GAL. TILT BRAISING PAN- GAS MANUAL TILT

QUANTITY 1

Manufacturer: Cleveland
Model: SGL40T1
Size and Shape: Refer to drawings
Alternate: Groen

1. Tilt braising pan with easyDial Controls, selector dial with LED ring, large display screen.
2. Easy manual tilt, spring-assisted cover with vent.
3. S/S construction.
4. Open leg frame.
5. Steamer pan inserts.
6. Pan carrier.
7. Etch marks.
8. Double pantry swing faucet.
9. Flanged feet. Secure rear to floor with non-corrosive anchors.
10. Provide quantities and sizes required: Dormont Model #VER-KITCF-2S-48" Gas Conn. Kit, 48" long, dble. Supr-Swivel coupling with SafetyQuick safety fitting, w/coiled restraining device, full port gas valve, antimicrobial coating, lifetime warranty.
11. Trench Liner to consist of:
12. S/S trench liner by 114000. Installation by G.C.
13. IMC/Teddy or Custom Fabrication.
14. Fibergrate: Gray #2 1" Thick, 1 1/2" squares mesh, Quartz grit top. Provide in two (2) equal sections, all ends to be finished ends.
15. 14 gauge s/s liner
16. IMC Teddy model no. BSPC basket strainer with pullout handle and chain.
17. Location of trench liner is critical. G.C. and 114000 to verify location prior to concrete pour. Oversize trench liner block out to accommodate equipment pour path.

ITEM NO. 167 MOBILE PIZZA CUTTING TABLE

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: Aero, Eagle

1. Top: 14 gauge type 304 S/S with 2" turndown at all sides.
2. Open base construction.
3. 16 gauge S/S undershelf per drawings.
4. One (1) 20" W x 20" L drawer assemblies. Component Hardware #S52-2020 drawer slides with delrin bearings - 200lb capacity. Component Hardware #S80-2020 drawer pan.
5. 5" N.S.F. approved non-marking swivel casters, two with brakes.

ITEM NO. 168 SS WALL CAP

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: Aero, Eagle

1. 2" square turndown at free ends.
2. Caulk and seal at wall with clear silicone.
3. Eased edges at exposed corners.
4. Coved turn up at full height wall, extended to ceiling.
5. Locate per drawings.

ITEM NO. 169 SS CORNER GUARDS

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: Aero, Eagle

1. Quantity (1) equals One Lot, located on every outside corner within kitchen.
2. 18 ga. stainless steel corner guards located at all exposed corners of kitchen. 48" tall. Located at all corners within the kitchen area. Secure to wall with hidden fasteners.

ITEM NO. 170 STAINLESS STEEL WALL PANEL

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: Aero, Eagle

1. Quantity of one (1) equal to one (1) LOT. All S/S/ wall panels shown per drawing
2. 18 gauge flat Stainless steel paneling from floor to top of wall.
3. Contain raw edges in stainless steel trim strips.
4. Extend from top of covered base to top of wall.
5. S/S panels to be full length of walls and wrap both ends of wall.
6. S/S panels to wrap structural columns.

ITEM NO. 172 COMBI OVEN - GAS DBL

QUANTITY 1

Manufacturer: Rational
Model: ICP 6-FULL/6-FULL N/G
Size and Shape: Refer to drawings
Alternate:

1. Pre-Installation Site Consultation, to verify building utilities and access are in place for the units ordered prior to units being installed on site.
2. 208/240V 1PH
3. Doors hinged on right.
4. Six (6) 18" x 26" or twelve (12) 12" x 20" pan capacity, per unit.
5. Standard warranty: 2 year parts and labor, installation inspection/start up.
6. Doors hinged per drawings.
7. Combi-Duo Stacking Kit, mobile.
8. Cleaner Tablets
9. Care Tablets.
10. AutoDose option, with Cartridge chemicals.
11. Gastronorm Grid Shelf, qty. 3.
12. Fry baskets, qty. 3 per oven.
13. Grill & Pizza Tray.
14. Gastronorm CombiGrill.
15. Gastronorm Potato Baker, 1/1 size, 12" x 20".
16. Grilling & Roasting Plate.
17. KEC to coordinate pan accessories with Owner prior to ordering.
18. Four hour chef training.
19. Heat shield.
20. Installation Kit "10", per unit, article number 8720.1560US.
21. Rational offers Certified Installation of units by Commercial Kitchens.
22. System installation to be reviewed by an authorized factory installer, provide report confirming installation meets factory's requirements.
23. System to be interconnected to remote filter system, Item 264. KEC to coordinate with G.C. as required.
24. Provide sizes and quantities as required: Dormont s/s water disconnect from filter to Combi Oven,color coded for filtered and non-filtered water.
25. KEC to coordinate filtered and unfiltered water with Combi Oven, do not connect filtered water to unfiltered water connection.

26. Provide quantities and sizes required: Dormont Model #VER-KITCF-2S-48" Gas Conn. Kit, 48" long, dble. Supr-Swivel coupling with SafetyQuick safety fitting, w/coiled restraining device, full port gas valve, antimicrobial coating, lifetime warranty.
27. Water supply to have shut-off valve and back flow preventer furnished and installed by Division 22. Supply water to interconnect thru water filter and then to each oven. Indirect drain line to be ran outside of the footprint of the unit, coordinate location of the related floor sink.

ITEM NO. 172A COMBI OVEN - DBL

QUANTITY 1

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.
6. Provide quantities and sizes required: T&S Model #HG-4VERIFY-48SK Antimicrobial Coated Hose w/NPT Male Ends, Swivel Links, 2-Piece Quick Disconnect, 90° Elbow & Installation Kit w/coiled restraining device, full port gas valve, lifetime warranty. Alternate: Dormont
7. Provide sizes and quantities as required: T&S model #HW-6VERIFY-48 water hose and disconnect from filter to steamer, color coded for filtered and non-filtered water.
Alternate: Dormont

ITEM NO. 187 PASS-THRU HEATED CABINET- 2DR

QUANTITY 3

Manufacturer: Traulsen
Model: HF-232WP
Size and Shape: Refer to drawings
Alternate:

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. Universal 18" x 26" and 12" x 20" pan files on 4" centers in all sections.
6. 6" high adjustable S/S legs.
7. Furnish startup and Six (6) years parts and labor warranty.
8. Controls mounted on kitchen side.
9. Full height doors hinged as per plan. Glass doors located on both kitchen and servery sides

10. Re-hinging feature.
11. Provide opening in wall 2" taller than equipment and 2" wider, KEC to coordinate with GC as required. Trim is not to be secured to the equipment.

ITEM NO. 189 PASS-THRU REFRIGERATOR - 2DR

QUANTITY 2

Manufacturer: Traulsen
Model: HT-232WPUT
Size and Shape: Refer to drawings
Alternate:

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. Universal 18" x 26" and 12" x 20" pan files on 4" centers in all sections.
6. 6" high adjustable S/S legs.
7. Furnish start-up and Six (6) years parts and labor warranty.
8. Seven (7) Year compressor warranty.
9. Controls mounted on kitchen side.
10. Full height doors hinged as per plan. Glass doors located on both kitchen and servery sides
11. Re-hinging feature.
12. Omit plug. Unit to be Hard Wired.
13. Special Instruction: Provide opening in wall 2" taller than equipment and 2" wider, KEC to coordinate with GC as required. Trim is not to be secured to the equipment.

ITEM NO. 193 REACH-IN REFRIGERATOR - 2DR

QUANTITY 1

Manufacturer: Traulsen
Model: HT-232WUT
Size and Shape: Refer to drawings
Alternate:

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. Five (5) s/s shelves per door.
6. 6" high adjustable S/S legs.
7. Furnish start-up and Six (6) years parts and labor warranty.
8. Seven (7) Year compressor warranty.
9. Omit plug. Unit to be Hard Wired.
10. Full height S/S doors hinged as per plan.
11. Re-hinging feature.

ITEM NO. 195 REACH-IN FREEZER - 2DR

QUANTITY 1

Manufacturer: Traulsen
Model: LT-232WUT
Size and Shape: Refer to drawings
Alternate:

1. Anodized aluminum interior and S/S exterior.
2. Interior lights with bulbs.
3. Exterior digital thermometer.
4. Locking hardware.
5. Five (5) s/s shelves per door.
6. 6" high adjustable S/S legs.
7. Furnish start-up and Six (6) years parts and labor warranty.
8. Seven (7) Year compressor warranty.
9. Omit plug. Unit to be Hard Wired.
10. Full height S/S doors hinged as per plan.
11. Re-hinging feature.

ITEM NO. 196 BACK COUNTER - OPEN BASE

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: Aero, Eagle

1. Top: 14 gauge type 304 S/S, 2" turn down at free sides. 4" splash where adjacent to equipment and walls.
2. Open base construction.
3. Full length 16 gauge S/S undershelf.
4. 6" S/S adjustable feet.

ITEM NO. 201.1 HOT ACTION COUNTER

QUANTITY 1

Manufacturer: CounterCraft
Model: ---
Size and Shape: Refer to drawings
Alternate:

1. Continuous semi-open base, angle iron frame construction; utility chase within the counter. All electrical conduits and plumbing are to be within utility chase as required - utility chase to be fully accessible from the operator side of the counter with removable stainless-steel panels.
2. All electrical is to be pre-wired to the load center. Electrical is to be located in an electrical conduit pipe, and flex conduit is to be kept to a minimum. Exposed conduit will

not be accepted. All wiring is to be numbered at all junctions per circuit. A wiring diagram is to be provided at each load center door. All receptacles mounted in the counter are to be recess mounted and labeled.

3. Cashier stations to be integral with counter, closed base when located on the customer side of counter, open base when located on the operator side of the counter. Provide lockable cashier drawer with cash till, undershelf to accommodate owner's POS System, and an outlet to accommodate POS system and data line.
4. Stainless steel removable intermediate shelves and fully welded undershelves where possible.
5. Dedicated recessed receptacle to accommodate beverage merchandisers; coordinate location with drawings.
6. Provide a remote on/off switch for beverage merchandisers if the standard location is not accessible.
7. Dedicated receptacle for any/all countertop equipment with grommeted holes. Coordinate location with equipment.
8. Adjustable kickplates.
9. 42" deep Continuous countertop 3CM Stone countertop located at 34" A.F.F. Verify stone selection prior to bidding if not specified. Submit a 12" X12" sample to the architect for approval.
10. Provide proper support below countertop to mitigate cracking or stone breakage. All cut outs to be radius to mitigate stone cracking.
11. LED Tray slide lights. Provide an on/off switch at the cashier's station.
12. Modify counter to accommodate Item No. 819 Griddle, all interior exposed finishes to be stainless steel.
13. One (1) lot Hatco HWBIBRT-FULD 1200-watt bottom mount insulated hot food wells located per drawings. Recess countertop at hot food wells to accommodate sheet pan. Manifold all drains to one open/close valve located below the counter in an accessible location. QUANTITIES AND SIZES PER PLANS.
14. One (1) lot Duke DRY HCF (INDIVIDUAL WELLS) hot/cold/freeze units. Refer to drawings for size. Top mount with flush mount pans, individually controlled wells (Hot/Cold/Freeze), and slide-out compressor.
15. Deck mount single pantry fill faucet T&S Model no. B-0208.
16. Manifoldd drains lead to a single 3/4" turn ball valve mounted in a full stainless-steel housing. Drain valve is to be located on the operator's side for ease of access.
17. Hatco black stone heated top; refer to drawings for size and location.
18. Hot food well covers; verify color selection with the architect.
19. Stainless steel louvered panels to be provided on the operator's side only at compressor locations. Louvers to be provided per the manufacturer's minimum requirements.
20. Dekton or stone insets at heated and frost top locations.
21. Sneeze guards to be located 22" above countertop with lights and double heat lamps.
22. CounterCraft BGA sneeze guards, mirror finish, single tier at hot food wells, and single tier at cold pans/frost tops. 3/8" Tempered glass. Height to be 18" above countertop. Glass to be adjustable to accommodate self and full-service operation. Heat lamps with lights located at hot food well and heated tops, lights over the cold sections. Size to

- accommodate equipment. Provide mirror finishes. All Sneeze Guards to meet all NSF and local health code requirements.
23. End glass to be provided to adjust with the front glass and brackets to maintain all NSF and local health codes.
 24. Vertical glass sneeze guard to accommodate Item No. 819 Griddle.
 25. Sneeze guards to be secured to base of counter and welded to countertop. If stone top construction, extend thru countertop and secure to base, provide matching color sealant to match countertop.
 26. Backer board finish installed by the manufacturer to accept tile by G.C. Coordinate finish with GC.
 27. Counters to be factory installed, Manufacturer to provide floor template and coordinate with server walls, furr downs, electrical and plumbing locations. KEC To coordinate installation and any site conditions with the Trade/General Contractor as required.
 28. Manufacturers are to bid all items per specifications; deviations from the specified manufacturers or fabrication will not be accepted.

ITEM NO. 201.2 HOT SERVICE COUNTER

QUANTITY 1

Manufacturer: CounterCraft
Model: ---
Size and Shape: Refer to drawings
Alternate:

1. Continuous semi-open base, angle iron frame construction; utility chase within the counter. All electrical conduits and plumbing are to be within utility chase as required - utility chase to be fully accessible from the operator side of the counter with removable stainless-steel panels.
2. All electrical is to be pre-wired to the load center. Electrical is to be located in an electrical conduit pipe, and flex conduit is to be kept to a minimum. Exposed conduit will not be accepted. All wiring is to be numbered at all junctions per circuit. A wiring diagram is to be provided at each load center door. All receptacles mounted in the counter are to be recess mounted and labeled.
3. Cashier stations to be integral with counter, closed base when located on the customer side of counter, open base when located on the operator side of the counter. Provide lockable cashier drawer with cash till, undershelf to accommodate owner's POS System, and an outlet to accommodate POS system and data line.
4. Stainless steel removable intermediate shelves and fully welded undershelves where possible.
5. Dedicated recessed receptacle to accommodate beverage merchandisers; coordinate location with drawings.
6. Provide a remote on/off switch for beverage merchandisers if the standard location is not accessible.
7. Dedicated receptacle for any/all countertop equipment with grommets holes. Coordinate location with equipment.
8. Adjustable kickplates.

9. 42" deep Continuous countertop 3CM Stone countertop located at 34" A.F.F. Verify stone selection prior to bidding if not specified. Submit a 12" X12" sample to the architect for approval.
10. Provide proper support below countertop to mitigate cracking or stone breakage. All cut outs to be radius to mitigate stone cracking.
11. LED Tray slide lights. Provide an on/off switch at the cashier's station.
12. One (1) lot of bowl lowerators, locate per drawings, coordinate size with owner prior to ordering.
13. One (1) lot Hatco HWBIBRT-FULD 1200-watt bottom mount insulated hot food wells located per drawings. Recess countertop at hot food wells to accommodate sheet pan. Manifold all drains to one open/close valve located below the counter in an accessible location. QUANTITIES AND SIZES PER PLANS.
14. One (1) lot Duke DRY HCF (INDIVIDUAL WELLS) hot/cold/freeze units. Refer to drawings for size. Top mount with flush mount pans, individually controlled wells (Hot/Cold/Freeze), and slide-out compressor.
15. Deck mount single pantry fill faucet T&S Model no. B-0208.
16. One (1) lot Hatco drop in mechanical cold pan, sized per plan.
17. Manifolged drains lead to a single 3/4" turn ball valve mounted in a full stainless-steel housing. Drain valve is to be located on the operator's side for ease of access.
18. Hot food well covers; verify color selection with the architect.
19. Stainless steel louvered panels to be provided on the operator's side only at compressor locations. Louvers to be provided per the manufacturer's minimum requirements.
20. Dekton or stone insets at heated and frost top locations.
21. Sneeze guards to be located 22" above countertop with lights and double heat lamps.
22. CounterCraft BGA sneeze guards, mirror finish, single tier at hot food wells, and single tier at cold pans/frost tops. 3/8" Tempered glass. Height to be 18" above countertop. Glass to be adjustable to accommodate self and full-service operation. Heat lamps with lights located at hot food well and heated tops, lights over the cold sections. Size to accommodate equipment. Provide mirror finishes. All Sneeze Guards to meet all NSF and local health code requirements.
23. End glass to be provided to adjust with the front glass and brackets to maintain all NSF and local health codes.
24. Sneeze guards to be secured to base of counter and welded to countertop. If stone top construction, extend thru countertop and secure to base, provide matching color sealant to match countertop.
25. Backer board finish installed by the manufacturer to accept tile by G.C. Coordinate finish with GC.
26. Counters to be factory installed, Manufacturer to provide floor template and coordinate with servery walls, furr downs, electrical and plumbing locations. KEC To coordinate installation and any site conditions with the Trade/General Contractor as required.
27. Manufacturers are to bid all items per specifications; deviations from the specified manufacturers or fabrication will not be accepted.

ITEM NO. 201.4 DESSERT COUNTER

QUANTITY 1

Manufacturer: CounterCraft
Model: ---
Size and Shape: Refer to drawings
Alternate:

1. Continuous semi-open base, angle iron frame construction; utility chase within the counter. All electrical conduits and plumbing are to be within utility chase as required - utility chase to be fully accessible from the operator side of the counter with removable stainless-steel panels.
2. All electrical is to be pre-wired to the load center. Electrical is to be located in an electrical conduit pipe, and flex conduit is to be kept to a minimum. Exposed conduit will not be accepted. All wiring is to be numbered at all junctions per circuit. A wiring diagram is to be provided at each load center door. All receptacles mounted in the counter are to be recess mounted and labeled.
3. Cashier stations to be integral with counter, closed base when located on the customer side of counter, open base when located on the operator side of the counter. Provide lockable cashier drawer with cash till, undershelf to accommodate owner's POS System, and an outlet to accommodate POS system and data line.
4. Stainless steel removable intermediate shelves and fully welded undershelves where possible.
5. Dedicated recessed receptacle to accommodate beverage merchandisers; coordinate location with drawings.
6. Provide a remote on/off switch for beverage merchandisers if the standard location is not accessible.
7. Dedicated receptacle for any/all countertop equipment with grommeted holes. Coordinate location with equipment.
8. Adjustable kickplates.
9. 42" deep Continuous countertop 3CM Stone countertop located at 34" A.F.F. Verify stone selection prior to bidding if not specified. Submit a 12" X12" sample to the architect for approval.
10. Provide proper support below countertop to mitigate cracking or stone breakage. All cut outs to be radius to mitigate stone cracking.
11. LED Tray slide lights. Provide an on/off switch at the cashier's station.
12. One (1) lot of bowl lowerators, locate per drawings, coordinate size with owner prior to ordering.
13. One (1) lot Duke DRY HCF (INDIVIDUAL WELLS) hot/cold/freeze units. Refer to drawings for size. Top mount with flush mount pans, individually controlled wells (Hot/Cold/Freeze), and slide-out compressor.
14. Deck mount single pantry fill faucet T&S Model no. B-0208.
15. Manifoldded drains lead to a single 3/4" turn ball valve mounted in a full stainless-steel housing. Drain valve is to be located on the operator's side for ease of access.

16. Provide cut-out to accommodate Item No. 808 Ice Cream Dipping Cabinet, exposed interior to be stainless steel. Provide dedicate receptacle to accommodate dipping cabinet.
17. Coordinate Item No. 809 Dipper Well with counter as required.
18. Hot food well covers; verify color selection with the architect.
19. Stainless steel louvered panels to be provided on the operator's side only at compressor locations. Louvers to be provided per the manufacturer's minimum requirements.
20. Dekton or stone insets at heated and frost top locations.
21. Sneeze guards to be located 22" above countertop with lights and double heat lamps.
22. CounterCraft BGA sneeze guards, mirror finish, single tier at hot food wells, and single tier at cold pans/frost tops. 3/8" Tempered glass. Height to be 18" above countertop. Glass to be adjustable to accommodate self and full-service operation. Heat lamps with lights located at hot food well and heated tops, lights over the cold sections. Size to accommodate equipment. Provide mirror finishes. All Sneeze Guards to meet all NSF and local health code requirements.
23. End glass to be provided to adjust with the front glass and brackets to maintain all NSF and local health codes.
24. Sneeze guards to be secured to base of counter and welded to countertop. If stone top construction, extend thru countertop and secure to base, provide matching color sealant to match countertop.
25. Backer board finish installed by the manufacturer to accept tile by G.C. Coordinate finish with GC.
26. Counters to be factory installed, Manufacturer to provide floor template and coordinate with servery walls, furr downs, electrical and plumbing locations. KEC To coordinate installation and any site conditions with the Trade/General Contractor as required.
27. Manufacturers are to bid all items per specifications; deviations from the specified manufacturers or fabrication will not be accepted.

ITEM NO. 249 THREE COMPARTMENT SINK WITHOUT DISPOSER

QUANTITY 1

Manufacturer: Custom Fabricated
 Model: ---
 Size and Shape: Refer to drawings
 Alternate: Aero, Eagle

1. Top: 14-gauge S/S 3" high 1-1/2" rolled rim at free sides, 10" high splash at walls.
2. Open base construction.
3. Omit rear rail at sink.
4. Three (3) 30" x 26" x 15" deep sink compartment.
5. Provide One (1) T&S model no. B-0133-EE-CR-8C pre-rinse with add-a-faucet, two (2) B-0108-C spray head, two(2) B-0109-04 18" long wall bracket (dealer to cut to correct length), one (1) additional spray face model no. 108SFRK with ceramic cartridges.
6. One (1) T&S model no. B-0291, splash mount faucet, 18" swing nozzle, LL inlets, for 3/4" hot and cold water connections.

7. Three (3) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
8. Omit front rail at hose bibb.
9. 16-gauge S/S undershelf as per drawings.
10. Flanged feet at front only of counter.
11. Anchor flanged feet to floor with non-corrosive bolts. Secure wall mounted equipment / components to in wall grounds or anchor plates. Coordinate installation with the general contractor.
12. Coordinate with Item No. 708 Scrap Collector, locate per plans

ITEM NO. 254 SOILED & CLEAN DISHTABLE

QUANTITY 2

Manufacturer: Aero
Model: ---
Size and Shape: Refer to drawings
Alternate:

1. Top: 14 gauge type 304 S/S 3" high 1-1/2" rolled rim at free sides. 10" high splash at walls.
2. Provide 1/2" slope in top towards Pot Pan wash per the general specifications.
3. 2 1/2" backsplash at dishmachine portion, single thickness of s/s will not be accepted.
4. Anchor flanged feet to floor with non-corrosive bolts. Secure wall mounted equipment / components to in wall grounds or anchor plates. Coordinate installation with the general contractor.
5. Coordinate fabrication with Item No. 822 Pot Pan Wash

ITEM NO. 254.1 MAIL SLOT DISHTABLE

QUANTITY 1

Manufacturer: Aerowerks
Model:
Size and Shape: Refer to drawings
Alternate:

1. Size and shape per drawings.
2. Coordinate with Item No. 708 Scrap Collector.
3. System to be provided as a complete operating system, manufacturer to provide all necessary hardware and/or components for a complete operating system.
4. Top: 14 gauge stainless steel 3" high 1-1/2" rolled rim at free side, 10" high splash at wall.
5. Provide One (1) T&S model no. B-0133-EE pre-rinse, B-0108-C spray head, two(2) B-0109-04 18" long wall bracket (dealer to cut to correct length), one (1) additional spray face model no. 108SFRK with ceramic cartridges.
6. Slope dishtable to scrap trough and trough.
7. Provide 12" raised landing at soiled drop-off per drawings.

8. Mail slot tray drop off located at customers side of table. Slots to be 15" wide x 8" tall x 12" deep, fully welded, five (5) tier high and to maximize window width. Coordinate size with drawings.
9. One (1) trash chute with rubber trash block. Locate per drawings.
10. Scrap trough with six (6) flush inlets, trough to be fully welded to scrap trough assembly, coordinate trough requirements with Item No. 708 Scrap Collector. Trough to include flow controls located in a accessible location by owner.
11. One (1) Chicago model no. B512 - blending valve, pre-pipe from blending valve to flush inlets by section 11400. Mount blending valve on stainless steel bracket.
12. Three (3) 2'-0" perforated stainless steel sliding trough covers.
13. Scrap trough water connections to be pre-piped by Aerowerks, final connection by trade contractor. Refer to drawings.
14. Fully welded bracket to accommodate two (2) scrap collector controls.

ITEM NO. 255 MOBILE DRYING RACK

QUANTITY 4

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.

ITEM NO. 262 HAND SINK

QUANTITY 10

Manufacturer: Royal Industries
Model: ROY HSW 15 SP
Size and Shape: Refer to drawings
Alternate:

1. Hand Sink, wall model, 12" wide x 10" front-to-back x 6" deep bowl.
2. 3 1/2" gooseneck splash mount faucet with wrist blade operation.
3. Basket drain and wall bracket.
4. P-Trap assembly, delete open/close drain valve.
5. Soap and Towel Dispensers by Owner.
6. Removable end splashes on sides as required by code. Height same as the rear splash.
7. Division 22 to provide temperature adjustment valves as required
8. Include eye wash station at one (1) sink, locate per plans.

ITEM NO. 264 REVERSE OSMOSIS SYSTEM

QUANTITY 1

Manufacturer: 3M
Model: SCALEGARD HP Reverse Osmosis
Size and Shape: Refer to drawings
Alternate:

1. Manufacturer to size system to accommodate equipment as required.
2. 3M Purification Model No. SCALEGARD HP 120V Reverse Osmosis System.
3. SCALEGARD Install Kit.
4. 40 gallon RO tank.
5. Four (4) 3M Purification Model No. CFS22
6. To be interconnected to any/all cold water equipment, including; Ice Machines, Combi Ovens, Convection Steamers or Beverage Equipment.
7. Factory to submit shop drawings for review and approval.
8. Factory to perform startup and confirm all equipment interconnections. Provide letter with warranty confirming installation meets manufacturer requirements.
9. Special Instructions: Division 22 to provide and install all interconnection tubing and components required by system.
10. Provide two sets of replacement filters.

ITEM NO. 265 TILT KETTLE 40 GA.

QUANTITY 1

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.
6. Provide quantities and sizes required: T&S Model #HG-4VERIFY-48SK Antimicrobial Coated Hose w/NPT Male Ends, Swivel Links, 2-Piece Quick Disconnect, 90° Elbow & Installation Kit w/coiled restraining device, full port gas valve, lifetime warranty. Alternate: Dormont

ITEM NO. 532 HOSE REEL

QUANTITY 1

Manufacturer: T&S Brass and Bronze
Model: B-1433
Size and Shape: Refer to drawings
Alternate:

1. Modified with B-0210:-N faucet base for hot water only.

2. Hose reel assembly, enclosed 3/8" x 50 ft. hose, table leg mounted.
3. Quarter-turn Eterna cartridges with spring check, lever handle with color coded indexes.
4. EasyInstall 16" and 40" risers (with control valve between risers), continuous pressure vacuum breaker.
5. 3/8" NPT x 36" flexible water hose connector with stainless steel quick disconnect, high flow spray valve with heat resistant blue hand and hold down ring (EB-0107).
6. Ratcheting system and adjustable hose bumper.
7. Two (2) 2-3/4" wall brackets, stainless steel hose reel, polished chrome plated brass faucet body.
8. Exposed piping to be sleeved in chrome.
9. KEC to provide complete assembly.
10. Add #G018477-45 Leg Bracket for hose reels.

ITEM NO. 633 GRIDDLE

QUANTITY 1

Manufacturer: Vulcan
Model: 936RX-30
Size and Shape: Refer to drawings
Alternate:

1. Size and shape per plan.
 2. S/S stand with Marine edges and casters, two (2) with brakes.
 3. Stainless steel construction.
 4. Electric spark ignition.
 5. 3-1/2" wide stainless steel grease trough drain.
 6. 3/4" rear gas connection and gas pressure regulator.
 7. Provide quantities and sizes required: T&S Model #HG-4VERIFY-48SK Antimicrobial Coated Hose w/NPT Male Ends, Swivel Links, 2-Piece Quick Disconnect, 90° Elbow & Installation Kit w/coiled restraining device, full port gas valve, lifetime warranty.
- Alternate: Dormont

ITEM NO. 644 ELECTRIC CORD REEL

QUANTITY 6

Manufacturer: By Electrical Contractor
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Provided by Trade Contractor.

ITEM NO. 646 CUP DISPENSER

QUANTITY 3

Manufacturer: Owner Furnished
Model:
Size and Shape: Refer to drawings

Alternate:

ITEM NO. 660 CHARBROILER

QUANTITY 1

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.
6. Provide quantities and sizes required: T&S Model #HG-4VERIFY-48SK Antimicrobial Coated Hose w/NPT Male Ends, Swivel Links, 2-Piece Quick Disconnect, 90° Elbow & Installation Kit w/coiled restraining device, full port gas valve, lifetime warranty. Alternate: Dormont

ITEM NO. 708 SCRAP COLLECTOR

QUANTITY 2

Manufacturer: Salvajor
Model: P914
Size and Shape: Refer to drawings
Alternate:

1. Scrap Collector to be scrapping, pre-flushing and food waste collecting system with re-circulating water.3/4 HP motor.
2. Pot/Pan Scrap basin. Fully welded to soiled dishtable.
3. Provide two (2) additional scrap basket.
4. Automatic Water Blender.
5. Solenoid valve.
6. Unions.
7. Check Valves, Incoming Water Valves.
8. Backflow prevention device.
9. Provide remote on/off controls
10. Delete standard syphon breakers and provide T & S B-0456-04 vacuum breakers and mount 6" from tabletop to base of breaker.
11. Install vacuum breaker in splash.
12. Utilities provided as shown in Contract Documents.

ITEM NO. 800 TEN BURNER RANGE

QUANTITY 1

Manufacturer: Garland
Model: G60-10SS

Size and Shape: Refer to drawings
Alternate: Vulcan, Montague

1. Cabinet base
2. Stainless steel front, sides,
3. 1" rear gas connection.
4. Heavy duty casters, two (2) with locking breaks.
5. Standing pilots
6. Provide quantities and sizes required: Dormont Model #VER-KITCF-2S-48" Gas Conn. Kit, 48" long, dble. Supr-Swivel coupling with SafetyQuick safety fitting, w/coiled restraining device, full port gas valve, antimicrobial coating, lifetime warranty.
7. Low profile backguard

ITEM NO. 801 DECK OVEN

QUANTITY 1

Manufacturer: Blodgett
Model: 911P
Size and Shape: Refer to drawings
Alternate: Bakers Pride, Beech, Woodstone

1. Triple deck deck oven
2. Three (3) 7" bake decks with 1" hearthite deck
3. Stainless steel front , sides, top, back, and legs
4. Snap/throttle temperature control
5. Balanced oven door open fully width, level with deck.
6. Controls to be located outside of heat zone
7. Provide quantities and sizes required: Dormont Model #VER-KITCF-2S-48" Gas Conn. Kit, 48" long, dble. Supr-Swivel coupling with SafetyQuick safety fitting, w/coiled restraining device, full port gas valve, antimicrobial coating, lifetime warranty.

ITEM NO. 802 WORKTABLE

QUANTITY 2

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: Aero, Eagle

1. Top: 14 gauge type 304 S/S, 2" turn down at all sides.
2. Open base construction.
3. Full length 16 gauge S/S undershelf.
4. One (1) 15" x 20" x 10" deep sink compartment. Coordinate location with drain overflow.
5. One (1) T&S model no. B-0320-BB-CR, rigid gooseneck, ceramic cartridges, deck faucet for 3/4" hot and cold water connections.
6. One (1) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.

7. Omit rear cross rail at sink section.
8. Flanged feet, secured to the floor with non corrosive anchors.
9. One (1) lot Rubbermaid no. FG360288WHT ingredient bins. Locate per plans

ITEM NO. 803 TILT KETTLE 60 GA.

QUANTITY 1

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.
6. Provide quantities and sizes required: T&S Model #HG-4VERIFY-48SK Antimicrobial Coated Hose w/NPT Male Ends, Swivel Links, 2-Piece Quick Disconnect, 90° Elbow & Installation Kit w/coiled restraining device, full port gas valve, lifetime warranty. Alternate: Dormont

ITEM NO. 804 PIZZA PREP TABLE

QUANTITY 1

Manufacturer: U-Line
Model: UCPP566-SS61A
Size and Shape: Refer to drawings
Alternate:

1. Size and Shape per plans
2. 3cm marble top, color to be selected by Owner/Architect
3. Elevated Refrigerated Rail U-Line UCGAC166, three (3) 1/3 pan capacity. Provide cord and plug, NEMA 5-15P
4. Undercounter ambient pizza dough drawers U-Line UCCATP
5. 304 Stainless steel interior and exterior
6. Electronic digital controls
7. Factory pre-wired dedicated outlet for raised refrigerated rail
8. Side mount compressor with high efficiency evaporator coil and condenser, autodefrost feature.

ITEM NO. 805 FLIGHT TYPE DISHMACHINE

QUANTITY 1

Manufacturer: Hobart
Model: FT1000e
Size and Shape: Refer to drawings

Alternate: --

1. Dishmachine to be factory installed and tested. Factory to provide report confirming installation has been installed per factory's requirements. Manufacturer to coordinate installation with the GC as required.
2. Low energy series ventless flight type dish machine.
3. 2 extended warranty for parts and labor.
4. Hobart to provide start-up and installation of dishmachine.
5. Automatic Soil Removal included.
6. Conveyor type to be verified with owner prior to ordering.
7. Load platform.
8. Dual rinse.
9. Standard non-split 8' center joined.
10. Blower dryer with extended warranty.
11. Standard height.
12. Electric heat.
13. 480V/60/3PH with single point connection.
14. Vent fan controls, coordinate interconnection with trade contractor.
15. Factory to coordinate the vent ducting with the KEC/Trade Contractor as required.
16. FT1000E-CBREHW EHW with circuit breaker, electric, high voltage.
17. FT1000E-CBRYES with circuit breaker.
18. Built-in booster heater.
19. Auto clean and delime cycle.
20. Standard hinge doors all sections.
21. Stainless steel rear finish.
22. (47 ft) SEF-1000-01 Conveyor - SST standard conveyor.
23. (67) SF-1000-33 Conveyor cross rods for SST conveyor.
24. FT1000E-SEFYES with SEF options.
25. WS80 water softening system 4,818 frains/lb capacity. Authorized Hobart service installation.
26. FLGFT-2PC1000 Flange feet 2pc, FT1000/1000S.
27. Locate in per plans.

ITEM NO. 806	DISH DOLLY	QUANTITY	8
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Manufacturer:	Owner Furnished
Model:	
Size and Shape:	Refer to drawings
Alternate:	

ITEM NO. 807	GLASS RACK DOLLY	QUANTITY	7
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Manufacturer:	Owner Furnished
Model:	

Size and Shape: Refer to drawings
Alternate:

ITEM NO. 808 ICE CREAM DIPPING CABINET

QUANTITY 1

Manufacturer: MasterBilt
Model: DD-26
Size and Shape: Refer to drawings
Alternate:

1. White powder coated interior and exterior
2. Flat tempered glass sliding lids
3. Lock and key set
4. Curved glass sneeze guard
5. Heated plastic lid frame to prevent frost build up
6. Internal condensate pan
7. Bottom defrost drain with plug
8. Heavy duty casters, two (2) with brakes
9. Removable rubber bumper guards
10. Cord and plug assembly

ITEM NO. 809 DIPPER WELL

QUANTITY 1

Manufacturer: T&S Brass
Model: B-2282-01
Size and Shape: Refer to drawings
Alternate:

1. Removable inner overflow cup
2. Solid brass knob, chrome plated
3. Extend drain to floor sink
4. Coordinate installation with Item No. 201.4 Dessert Counter

ITEM NO. 810 FRYER BATTERY

QUANTITY 2

Manufacturer: Pitco
Model: SSHLV14-2
Size and Shape: Refer to drawings
Alternate: ---

1. Digital controls with auto melt cycle.
2. 50lb oil capacity.
3. S/S fry tank and full baskets. Provide three (3) extra sets of full baskets.
4. S/S cabinet
5. Four (4) casters two (2) with brakes.

6. Fry pot cover.
7. Cord and plug assembly.
8. Provide quantities and sizes required: T&S Model #HG-4VERIFY-48SK Antimicrobial Coated Hose w/NPT Male Ends, Swivel Links, 2-Piece Quick Disconnect, 90° Elbow & Installation Kit w/coiled restraining device, full port gas valve, lifetime warranty. Alternate: Dormont
9. Provide built in filter system
10. Provide Two (2) FATVAT used oil removal cart

ITEM NO. 811 BEVERAGE DISPENSER QUANTITY 2

Manufacturer: Purveyor Furnished
Model:
Size and Shape: Refer to drawings
Alternate:

ITEM NO. 812 TEA/COFFEE BREWER QUANTITY 2

Manufacturer: Purveyor Furnished
Model:
Size and Shape: Refer to drawings
Alternate: ---

ITEM NO. 813 JUICE MACHINE QUANTITY 2

Manufacturer: Purveyor Furnished
Model:
Size and Shape: Refer to drawings
Alternate:

ITEM NO. 814 ICE MACHINE QUANTITY 1

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.
6. Provide sizes and quantities as required: T&S model #HW-6VERIFY-48 water hose and disconnect from filter to ice machine, color coded for filtered and non-filtered water.

ITEM NO. 815 CO2 BULK STORAGE TANK QUANTITY 1

Manufacturer: Purveyor Furnished/Purveyor Installed
Model:
Size and Shape: Refer to drawings
Alternate:

ITEM NO. 816 OIL RECYCLING TANK QUANTITY 1

Manufacturer: Purveyor Furnished/Purveyor Installed
Model:
Size and Shape: Refer to drawings
Alternate:

ITEM NO. 817 REFRIGERATED PREP STAND QUANTITY 1

Manufacturer: Traulsen
Model: TE036HT
Size and Shape: Refer to drawings
Alternate: ---

1. Right side compressor unit
2. Six (6) years parts and labor warranty. Seven (7) years compressor warranty.

ITEM NO. 818 PRODUCE WASH SINK QUANTITY 2

Manufacturer: Existing/Relocate
Model:
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.

ITEM NO. 819 GRIDDLE QUANTITY 1

Manufacturer: Vulcan
Model: 948RX
Size and Shape: Refer to drawings
Alternate:

1. Size and shape per plan.

2. S/S stand with Marine edges and casters, two (2) with brakes.
3. Stainless steel construction.
4. Electric spark ignition.
5. 3-1/2" wide stainless steel grease trough drain.
6. 3/4" rear gas connection and gas pressure regulator.
7. Provide quantities and sizes required: T&S Model #HG-4VERIFY-48SK Antimicrobial Coated Hose w/NPT Male Ends, Swivel Links, 2-Piece Quick Disconnect, 90° Elbow & Installation Kit w/coiled restraining device, full port gas valve, lifetime warranty.
Alternate: Dormont
8. Coordinate with Item No. 625 Refrig Equipment Stand.

ITEM NO. 820 BLAST CHILLER

QUANTITY 1

Manufacturer: Existing/Relocate
Model: QC2-100
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. Special Instructions: GC to disconnect/reconnect all utilities as required.

ITEM NO. 821 BLAST CHILLER

QUANTITY 1

Manufacturer: Existing/Relocate
Model: QC3-100
Size and Shape: Refer to drawings
Alternate:

1. Refer to General Specifications re: Existing/Relocated equipment.
2. KEC to coordinate relocation of all equipment per owners direction.
3. KEC to inventory all equipment and condition prior to removal from existing facility.
4. KEC is responsible for field verification of all utility requirements of existing equipment.
5. GC to disconnect/reconnect all utilities as required.

ITEM NO. 822 POT/PAN WASHER

QUANTITY 1

Manufacturer: Hobart
Model: PW20
Size and Shape: Refer to drawings
Alternate:

1. Sense-A-Temp booster heater

2. Front loading, split door configuration
3. Electric tank heat
4. Spray hose
5. Pressure regulator valve
6. One (1) Scaltrol SC100 water treatment unit
7. 480 volt / three phase connection
8. One (1) Extended warranty - One (1) Year parts and labor
9. Stainless steel adjustable legs.
10. 96" clearance required for full door open under hood, G.C. to coordinate with condensate hood mounting

END OF MAIN KITCHEN

**SECTION 12 3661
QUARTZ COUNTERTOPS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. PS 1 - Structural Plywood; 2023.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Quartz countertops and backsplashes.

1.04 ACTION SUBMITTALS

- A. Product Data: For countertop materials and sinks.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples for Initial Selection: For each type of material exposed to view.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.06 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 PRODUCTS

2.01 QUARTZ -MATERIAL COUNTERTOPS SS-1

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings:
 - 1. SS-1 Stratus Quartz – Kendall Concrete
 - a. 3 CM thickness
 - b. Provide Eased edge
 - 2. SS-2 Cambria Fieldstone Quartz – Slate Gray
 - a. 3 CM thickness
 - b. Provide Eased edge
- B. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Edge: 1-1/2-inch laminated eased-edge profile.
 - 2. Backsplash: Straight, slightly eased at corner. Provide back splash Only where indicated on drawings.
 - 3. Endsplash: Matching backsplash.
- C. Countertops: 3 CM- thick, material with front edge built up with same material.
- D. Backsplashes: 2CM- thick, quartz material.
- E. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing. If tops can not be fabricated to specified sizes with single piece, alert design team prior to fabrication.
 - 1. Fabricate with loose backsplashes for field assembly.
 - 2. Where indicated, install integral sink bowls in countertops in the shop.

- F. Substrate: Plywood, exterior soft plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch (3.18 mm) in 8 feet (243.84 cm) .
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 2. Seal edges of cutouts in particleboard subtops by saturating with varnish.

END OF SECTION

**SECTION 21 0500
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

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. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Fire-suppression equipment and piping demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe 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 in 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.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Mechanical sleeve seals.
 - 2. Escutcheons.
- B. In order to make the submittal review process more efficient for all parties, all MEP submittal data and shop drawings shall be reviewed on a designated "Submittal Review Day." The "Submittal Review Day" will consist of having the Engineer, General Contractor, Electrical Contractor and Mechanical HVAC Contractor review the submittals together, in the same room. The Architect and Owner's representative(s) will be invited to attend the "Submittal Review Day. Key Manufacturer's Representatives shall attend the review or be available by phone for immediate response to questions and/or comments. All submittals will be reviewed and stamped by the Engineer the same day. The Contractor is responsible for setting time and place for this review and inviting all required parties. All parties shall be given a minimum of 7

days notice prior to "Submittal Review Day."

1.05 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 Fire-Suppression 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.

1.06 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.

1.07 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression 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 fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.08 ELECTRICAL, PLUMBING, AND CONTROL CHARACTERISTICS OF EQUIPMENT

- A. The electrical, plumbing, and control characteristics of each item of equipment scheduled, noted and/or indicated on the plans and specifications are based on a particular manufacturer and model. While other manufacturers or models may be acceptable, it is the responsibility of the Contractor to verify that the electrical, plumbing, and controls characteristics for the equipment he proposes to provide match those indicated. In the instance where the equipment he proposes to provide has different electrical, plumbing, and controls characteristics, the Contractor AT NO COST TO THE OWNER shall provide the required electrical, plumbing, and controls characteristics required. All modifications to provide the electrical, plumbing, and control characteristics shall be coordinated by the Contractor with the Engineer.
- B. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.
- C. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.
- D. The date of acceptance by the Architect, for beneficial use by the Owner, shall be the beginning date of the warranty period.

1.09 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of each item of mechanical equipment shown on Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes

to furnish will fit into the space. Shop drawings shall be prepared when required by the Architect to indicate a suitable arrangement.

- B. Install equipment in a manner to permit access to all surfaces. Install valves, motors, drives, lubricating devices, filters, and other accessory items in a position to allow removal for service without requiring the disassembly of another part.
- C. Large equipment or components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. The equipment shall be protected until all hazards of damage to the equipment are eliminated.

1.10 OPERATING AND MAINTENANCE MANUALS

- A. Manuals shall be submitted which contain the following:
- B. Description of the system provided.
 - 1. Handling, storage, and installation instructions.
 - 2. Detailed description of the function of each principal component of the systems or equipment, including necessary piping diagrams and valve identification charts.
 - 3. Operating procedures:
 - a. Pre startup activities required.
 - b. Startup.
 - c. Normal operation.
 - d. Emergency shutdown.
 - e. Normal shutdown.
 - f. Trouble-shooting guide.
 - 4. Maintenance:
 - a. Complete lubrication requirements; type and source of lubricant, interval between lubrication, etc.
 - b. Preventative and repair maintenance procedures.
 - c. Complete spare parts list with cross reference to original equipment manufacturer part number.
 - 5. Control and alarm features:
 - a. A schematic of all control systems.
 - b. Control loop electric ladder diagrams and interlock diagrams.
 - c. A list of all controller operating set points.
 - d. A listing of all setting for alarms and shutdown system.
 - e. Provide pump curves for all pumps.
 - f. Provide fan curves for all fans.
 - 6. Safety and environmental considerations.
 - 7. Other data required elsewhere in the specifications.
- C. Three copies of the manuals shall be provided within sufficient time to allow for training of Owner's personnel. Submit one copy of the manuals to the Architect for review no later than 90 calendar days prior to substantial completion or building turn over, whichever comes first. Submit the remaining three corrected copies within 15 days after review set is returned to contractor. Progress payment may be withheld if this requirement is not met.
- D. The requirements for manuals apply to each package and field-fabricated operating system.
- E. The manuals shall be provided in three-ring side binders with durable plastic covers.
- F. The manuals shall contain a detailed table of contents and have tab dividers for major sections and special equipment.
- G. The Owner will not accept any training or equipment unless the maintenance manuals are received a minimum of 10 working days prior to request for Training/Turnover.

1.11 START-UP EQUIPMENT AND SYSTEMS

- A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer's start-up service (rendered by the manufacturer or his authorized representative) shall be provided.
- B. Witnessing and explanations of start-up services shall be included as part of the "Instruction of Owner's Personnel" as specified below.

1.12 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers or technicians acceptable to the Architect to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals.

1.13 AS-BUILT DRAWINGS

- A. The Contractor shall, during the progress of the job, keep a set of record prints on which he shall mark all changes. After completion of a CADD release form by the Contractor and near the conclusion of the job, the Architect will provide the Contractor with one set of AutoCAD electronic files of the Mechanical, Plumbing, and Electrical Drawings. The Contractor shall draft on these electronic files all changes made during the progress of the work and return them and one set of paper plans with the changes to the Architect as "As-Built Drawings".

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 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.

2.03 JOINING MATERIALS

- A. Refer to individual Division 21 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 (3.18 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.

2.04 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Available 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: Carbon steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) 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.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.06 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.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.07 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 (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.08 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials used for insulation, acoustical linings, adhesives, jackets and coatings, and combinations of these materials, shall each have a flame spread rating of 25 or less, and a smoke developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA-255.

2.09 FIRESTOPPING

- A. Provide firestopping in sealing of penetrations in fire-rated construction, horizontal and vertical, including the following materials:
 - 1. Foam: Dow Corning Firestop silicone RTV foam, liquid component Part A (black) and liquid component Part B (off-white).
 - 2. Sealant: 3M 1000NS and 1003SL silicone adhesive sealant, single component, neutral cure, and non-slumping.
 - 3. Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by the applicator.
- B. Mixes shall conform to the manufacturer's directions.

2.10 ACCESS PANELS AND DOORS

- A. Provide wall and ceiling access doors for unrestricted access to concealed valves, dampers, and other mechanical equipment items and devices.
- B. Access doors mounted in surfaces to be painted shall be Milcor Style "K" for plastered surfaces, and Style "M" for non-plastered surfaces. Style "K" doors shall be set with door flush with adjacent surfaces. Access doors mounted on tile surfaces shall be stainless steel and of similar construction to that described above. Access doors shall be not less than 12" x 12" in size.

PART 3 EXECUTION

3.01 FIRE-SUPPRESSION DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- D. Access: Access to and use of the existing facilities and site will be restricted, and shall be under the direction and control of the Owner.
- E. Disruptions: Maintain existing plumbing, heating, ventilating, air conditioning, fire protection, and other existing systems, and maintain all existing functions in service except for scheduled disruption. Where existing functions to remain in use are disrupted, they shall be fully restored after disruption, in full compliance with this Division of the Specifications for new work.
- F. Scheduling of Disruption: Seek and obtain approval two weeks in advance of event for date, starting, and duration of each required disruption.
- G. Notice of Disruption: Date, time and duration of each disruption shall be subject to the Owner's prior approval, and shall include the following information in the form of a memorandum submitted by the Contractor to the Architect for approval by the Owner:

STARTING

FACILITY/SYSTEM DATE TIME DURATION

- A. Emergency Disruptions: When circumstances preclude obtaining advance approval as specified above; make request immediately on knowledge of the requirement, and perform the work so as to cause the minimum amount of disruption, for the minimum duration.
- B. Notification: Notify the Architect and the owner immediately, by telephone and then in writing, as changes and additions to the scheduled disruption requirements become known.
- C. Duration: Complete as large a portion of the work as possible before initiating disruption and perform only that work necessary so as to minimize duration of disruption. Maintain adequate personnel, supplies, materials, equipment, tools, and other resources at job site to avoid unnecessary delay in resumption of normal service.
- D. General:
 - 1. Modify remove, or relocate materials and items indicated on the Drawings or required by the installation of new facilities.
 - 2. Remove demolition materials from the site and deliver salvage materials to destinations on the premises, as directed.
- E. Relocations:
 - 1. Repair and restore to good functional condition, equipment, materials and items scheduled for relocation, which are damaged during dismantling or reassembly operations.
 - 2. Remove carefully, in reserve order to original assembly or placement, items which are to be relocated.
 - 3. Protect items until relocation is complete.
 - 4. Clean and repair items to be relocated, and provide new materials, fittings, and appurtenances required to complete the relocations and to restore to good operating order.
 - 5. Perform the relocation work in accordance with applicable Sections of the Specifications, utilizing skilled workers.
- F. Relocating Devices: Remove and reinstall in locations designated by the Architect temperature control system devices, relays, piping, ductwork, equipment and other devices required for the operation of the various systems that are installed in existing-to-be-renovated construction.

5.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 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 Wall, Floor, or Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. 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 (50.8 mm) 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 (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) 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 (50.8 mm) 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.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches (152.4 mm) in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches (152.4 mm) 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.
- R. 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 (25-mm) 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.
- S. 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.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

5.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 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.

5.04 CONSTRUCTION REQUIREMENTS

- A. The Drawings and Specifications are intended to accomplish certain objectives. They show pipe and duct sizes, general routing and location, and describe the various systems. These documents describe and size equipment, its general location, usage, support and auxiliary requirements. They describe most, but not all of the materials and their usage for this project.
- B. Contract Documents do not, however, detail certain job requirements. They do not show exact layouts, locations or elevations of ducts, expansion joints, anchors, sleeves, hangers, slots, holes, outlets, inserts, elbows, fittings, thermometers, thermostats, gauges, wells, underfloor drains, sumps, or access doors. They do not show final precise locations of equipment by dimensions in most instances, or manufacturer's requirements for proper installation, operation and maintenance.
- C. The exact location of each item shall be determined by reference to the project Contract Drawings, and to details, equipment drawings, and roughing-in drawings, by measurements at the building, and in cooperation with the various trades. Minor relocations necessitated by the conditions at the site or directed by the Owner shall be made without additional cost to the Owner.
- D. Coordinate proper locations and sizes of slots, holes or openings in the building structure pertaining to this work, and for the correct location of sleeves. Place inserts to accommodate the ultimate installation of hangers in the forms, and set sleeves in forms before concrete is poured, and in masonry walls while they are under construction. Concealed lines shall be installed as required by the pace of the job to precede the general construction.
- E. Study construction documents and lay out piping work carefully in advance of fabrication and erection, in order to meet the requirements of the extremely limited spaces. Where conflicts occur, work with all involved trades and resolve the conflict prior to erection of any work in the area involved.

5.05 PAINTING

- A. Painting of fire-suppression 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.

5.06 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (101.6 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

5.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

- C. Field Welding: Comply with AWS D1.1.

5.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

5.09 GROUTING

- A. Mix and install grout for fire-suppression 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.

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SECTION 21 0548
VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

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.
- B. Refer to Vibration Controls for Piping and Equipment, Section 230548 for fire-suppression vibration controls.

PART 2 PRODUCTS – NOT USED.

PART 3 EXECUTION – NOT USED.

3.01 END OF SECTION 210548

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**SECTION 21 1100
FACILITY FIRE SUPPRESSION WATER-SERVICE PIPING**

PART 1 – GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012 (Reapproved 2021).
- B. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).
- C. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- D. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.
- E. AWWA C651 - Disinfecting Water Mains; 2023.
- F. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances; 2025.

1.02 RELATED DOCUMENTS

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

1.03 1.2 SUMMARY

- A. A. This section addresses underground fire-suppression water-service piping (fire mains) and its related components extending from the connection to the public water utility supply tap and extending into the building, as indicated on the approved design drawings.

1.04 1.3 SUBMITTALS

- A. Product Data: Manufacturer's specifications for each type of product to be used on project.
- B. Shop Drawings and details indicating locations and depths of underground main and FDC piping; size of pipe, fittings and valves; type of pipe and fittings materials; size, type and location of pressure blocking; type of backfill material(s); type(s) of underground risers; location and type of vaults, backflow devices, flow meters, and yard valves.
- C. Copies of the contracting firm's Texas Department of Insurance (TDI) Sprinkler Contractor Registration – General (SCR-G), Responsible Managing Employee - General (RME-G), Responsible Managing employee Underground (RME-U) and the required Texas Department of Insurance's Liability Insurance Certificate, signed by a Texas Insurance Agent.

1.4 QUALITY ASSURANCE

THE CONTRACTING FIRM INSTALLING THE UNDERGROUND FIRE MAIN SHALL SPECIALIZE IN THE DESIGN AND INSTALLATION OF UNDERGROUND FIRE MAINS. THE FIRM SHALL HAVE A MINIMUM OF THREE YEARS OF VERIFIABLE DESIGN AND INSTALLATION EXPERIENCE IN UNDERGROUND FIRE MAINS.

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

THE CONTRACTOR SHALL PROTECT ALL PIPING MATERIALS FROM CONTAMINATION DURING STORAGE, HANDLING AND INSTALLATION. ALL OPENINGS IN THE PIPELINE SHALL BE CLOSED WITH WATERTIGHT PLUGS WHEN PIPE LAYING IS STOPPED OR AT THE CLOSE OF THE DAY'S WORK.

- A. Regulatory requirements:
 - 1. Comply with all requirements of the public water purveyor's, TCEQ and UNT's requirements for connecting to the public utility water main.
 - 2. Comply with NFPA 24 and direction of UNT for materials, installation, tests, flushing, chlorination, valve and associated appurtenances for fire suppression water service

3. piping.
3. Comply with the "Approval Guide," published by FM Global, or UL's "Fire Protection Equipment Directory" for fire-service main products.
- B. Minimum Required Inspections:
1. Visual inspection of the installation shall be performed PRIOR TO covering any of the pipe, joints, fittings, valves, ductile iron, thrust blocks, restraints or other metal parts. Where any part is so covered prior to the visual inspection, the contractor will be required to uncover the part(s) for visual inspection at no cost to Owner.

4.02 PIPE LABELING MUST BE TURNED UPWARD AND VISIBLE.

1. Depth of bury of the pipe will be measured and verified.
2. All angle fittings shall be pressure blocked with poured-in-place cement pressure blocks or anchored retaining straps. Pressure and gravity anchor blocks shall be appropriately sized per NFPA 24 or by a Texas Professional Engineer and bear onto undisturbed soil.
3. All metal components being installed underground shall be externally coated for corrosion and poly-wrapped.

4.03 HYDROSTATIC TESTING OF THE FIRE SPRINKLER UNDERGROUND MAIN IS REQUIRED.

- A. All new fire service mains shall be tested hydrostatically at not less than 200 psi (1378.95 kPa) pressure for a minimum of two hours, or at 50 psi (344.74 kPa) pressure in excess of the maximum static pressure when the maximum required static pressure exceeds 150 psi.
- B. A pressure loss of more than 5 psig (34.47 kPa), or leaks will result in a failed inspection.
- C. The Hydrostatic test shall be made by the installing contractor and witnessed by the Owner's Representative.

4.04 CLEANING, DISINFECTING, FLUSHING AND BIOLOGICAL TESTING:

- A. Underground fire mains being connected to any potable water utility line must be disinfected, flushed and pass bacteriological testing prior to being connected to any potable water utility line.
- B. Isolate fire main system from public water utility main with RPZ backflow prevention device.
 - a. Clean new piping system and parts of existing system that have been altered, extended or repaired.
 - 1) Use flushing procedure described in NFPA 24 for flushing of pipe.
 - 2) Use disinfecting procedure described in AWWA C651.
 - 3) Once disinfecting test is complete and approved, re-flush the underground piping and perform bacteriological testing.
 - 4) Samples for bacteriological analysis will only be collected from suitable sampling taps and collected in sterile bottles treated with sodium thiosulfate. Samples shall not be drawn from hoses, fire hydrants or unregulated sources.
 2. Flushing, disinfecting, re-flushing and bacteriological sampling of lines shall be done by the installing contractor and witnessed by the Owner's Representative.
 3. Proper methods and equipment to perform the flush must be used. All piping used to flush must be properly secured or restrained. Owner's Representative must approve of flushing method and equipment.

1.4 COORDINATION

A. COORDINATE LOCATION OF UNDERGROUND FIRE MAIN WITH FIRE SPRINKLER CONTRACTOR, UNT UTILITIES SUPERVISOR AND PUBLIC WATER PURVEYOR'S REQUIREMENTS. COORDINATE FDC LOCATION AT THE DIRECTION OF THE UNT SYSTEM FIRE MARSHAL.

PART 2 -- PRODUCTS

7.01 2.1 WATER PIPING MATERIALS

- A. A. Underground -- Polyvinyl Chloride (PVC) Pipe (NO EXCEPTION)

1. 1. American National Standard for PVC pipe 12 inches (304.8 mm) and under, AWWA Standard C900, Class 200
 - a. (DR14).
 2. 2. Pipe greater than 12 inches (304.8 mm) shall be AWWA Standard C905, Class 200 (DR14).
 3. 3. Color: Blue
- B. B. Aboveground extension to backflow prevention device
1. 1. Where the underground fire service pipe emerges from below grade and does not immediately terminate with a control valve and backflow prevention device (double check valve assembly) in a readily accessible location, the above-ground extension of the fire service pipe shall be galvanized steel or stainless steel pipe run to the control valve and backflow prevention device located in a readily accessible location.
- C. Valves:
1. 1. Gate valves, 12" and under (resilient seated): AWWA C509 Standard
- D. General Description: Valves shall be full opening, iron body, non-rising stem, resilient seated wedge type so designed to have complete ZERO leakage with flow in either direction at pressures up to two hundred (200) psi. The valves shall be designed for throttling if required.
- E. Coating: Valves shall have all internal ferrous metal surfaces coated with an approved epoxy coating to provide a corrosion resistant barrier. The epoxy coating shall be holiday free with a minimum thickness of not less than four (4) mils. The coating shall be non-toxic after application and shall impart no taste to water.
- F. Operating stems: Valves shall have two (2) "O" ring stem seals. Valves shall have the thrust collar and bearing surfaces isolated from the waterway and be provided with continuous lubrication, or they shall be provided with non-corrosive thrust bearings above and below the thrust collar. Where the operating nut exceeds forty eight (48) inches, in depth (below finish grade), a permanently attached extension shall be attached to the valve stem to bring it to the minimum depth of forty-eight (48) inches. All valves shall open by turning to the left and shall have a two-(2) inch operating nut or be hand-wheel operated as shown on the plans.
1. Approved Manufacturers:
 - 1) Mueller
 - 2) Waterous
 - 3) Kennedy
 - 4) American-Darling
 - 5) Clow Corporation
 - 6) J&S Valves
- G. Fittings:
1. Mechanical Joint: ANSI/AWWA-C110/A21.10 or ANSI/AWWAC153/A21.53 Standards
 2. Flange Joint: ANSI/AWWA-C111/A21.11 or ANSI/AWWA-C153/A21.53 Standards
 3. Push-on Joint: ANSI/AWWA-C111-A21.10 or ANSI/AWWA-C153/A21.53 Standards
 4. Fittings: Ductile Iron ANSI/AWWA-C153/A21.53; Cast Iron ANSI/AWWAC110/A21.10 and ANSI/AWWA-C111/A21.11 Standards.
 5. Bends: ASTM D-3139. Megalug™ retaining glands or equal shall be used on all bends, tees and plugs
 6. Gaskets: ASTM F477 Standards
 7. Bolts, Bolt-studs and "T" Head Bolts:
- H. Length: Shall be such that the ends project ¼ to ½ inch beyond surface of nuts.
- I. Ends: Chamfer or rounded.
- J. Threading: ANSI B1.1 coarse thread series, class 2A Fit. Bolt-studs may be threaded full length. Studs for tapped holes shall be threaded to match threading in holes.
- K. All bolts, bolt-studs and "T" head bolts (ANSI/AWWA C111/A21.11-80) shall be either:

1. A242 high strength low alloy steel with enhanced atmospheric corrosion resistance (ASTM A325 Type III); or
 2. Stainless Steel Grade 304 or 316 high strength bolts
- L. All nuts are to be A563 carbon alloy steel; Grade and finish to be C3.
1. Exception: All-thread rod to be used in thrust harness only, shall be high strength, corrosion-resistant alloy (ASTM A325 Type II) with hexagonal nuts. Where all-thread rods, nuts and washer are used, they are to be painted with "ROYSTON ROSKOTE MASTIC R28" Rubberized mastic as manufactured by ROYSTON LABORATORIES, INC. of Pittsburgh, Pennsylvania or equivalent.

PART 3 - REACTION RESTRAINTS AND THRUST-BLOCKING

8.01 3.1 RESTRAINTS AND THRUST BLOCKING FOR ALL PIPING WITH MECHANICAL COUPLING, PUSH-ON OR MECHANICAL JOINTS, OR SIMILAR JOINTS SUBJECT TO INTERNAL PRESSURE SHALL BE THRUST-BLOCKED OR RESTRAINED PER NFPA 13 FOR UNDERGROUND PIPING TO PREVENT SEPARATION OF THE JOINTS.

8.02 1. THRUST-BLOCKING SHALL BE DESIGNED (PLACEMENT, SIZE, CEMENT MIX) BY THE RME OR A TEXAS REGISTERED PROFESSIONAL ENGINEER AND SHOWN ON THE INSTALLATION PLANS.

PART 4 - EXCAVATION

9.01 EXCAVATION: EXCAVATION IN GENERAL, SHALL BE MADE IN OPEN CUT FROM THE SURFACE OF THE GROUND AND SHALL BE NO GREATER IN WIDTH AND DEPTH THAN IS NECESSARY TO PERMIT THE PROPER CONSTRUCTION OF THE WORK.

EXCAVATING AND TRENCHING SHALL BE PERFORMED IN ACCORDANCE WITH STATE OF TEXAS LAW AND OSHA REQUIREMENTS.

1. Underground utilities in the area(s) being excavated shall be located, identified and marked by utility operator. Call TEXAS811 (dial 811), 48 hours in advance of the excavation and request line locates.

THE AMOUNT OF TRENCH EXCAVATION TO GRADE SHALL NOT EXCEED 100 (ONE HUNDRED) FEET FROM THE END OF THE PIPE LAYING OPERATIONS AND NO EXCAVATION SHALL BE 300 (THREE HUNDRED) FEET IN ADVANCE OF THE COMPLETED PIPE OPERATIONS (INCLUDES BACKFILLING). AT THE END OF THE WORKDAY, ALL TRENCH EXCAVATION SHALL BE BACKFILLED OR SURROUNDED WITH SUBSTANTIAL CHAIN-LINK FENCING AT LEAST 6 (SIX) FEET IN HEIGHT, ATTACHED TO STEEL POLES THAT ARE FIRMLY ANCHORED INTO THE GROUND. ANY LANDSCAPING, IRRIGATION SYSTEM, PAVING OR UTILITY THAT IS DISTURBED, REMOVED, OR DAMAGED DURING CONSTRUCTION SHALL BE REPLACED TO ORIGINAL CONDITION OR BETTER BY THE CONTRACTOR.

MINIMUM BURY DEPTH: MINIMUM BURY DEPTH SHALL BE FORTY-EIGHT (48) INCHES FROM FINISHED GRADE TO THE TOP OF THE PIPE OR AS DIRECTED BY THE OWNER.

BACKFILL COMPACTION:

1. Mechanical Method: Compaction and consolidation of the backfill materials shall be backfilled using the native material free of tree roots, large rocks and other deleterious materials, and compacted to 95 percent of maximum density as determined by ASTM D698 in six (6) inch lifts at optimum moisture content (to plus 4 percent above optimum moisture content) in areas subject to vehicular traffic, within 5 feet (152.4 cm) of and inside building footprints and other paved areas, and in ten (10) inch lifts in any other areas not specified. Where subject to vehicular traffic, within 5 feet of or inside the building footprint and other paved areas, density tests shall be performed at the rate of one test per 300 LF per one foot of trench depth.
2. Water Jetting Method: Water jetting is not allowed.

END OF SECTION

**SECTION 21 1313
FIRE PROTECTION SPRINKLER SYSTEMS**

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B31.9 - Building Services Piping; 2020.
- C. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2014 (Reapproved 2020).
- D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- E. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- F. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe; 2000.
- G. AWWA C606 - Grooved and Shouldered Joints; 2022.
- H. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.02 1.1 SUMMARY

- A. Section includes labor and materials for the installation of a hydraulically calculated automatic, sprinkler system(s), complete in all respects and ready for operation.
 - 1. Work includes the design of a hydraulically calculated, wet-pipe, automatic sprinkler system, designed for 100% coverage of the building.
 - a. In areas where ambient temperature cannot be maintained at 40° or above, a dry pipe sprinkler system or a monitored heat tape system shall be provided.
 - b. Design and installation of the sprinkler system shall be such that no parts interfere with general construction, doors, windows, heating, plumbing, air conditioning systems or electrical equipment.
 - 2. System components for each zone shall include, but not be limited to:
 - 3. Zone control valve and test/drain assembly.
 - 4. Drain valve.
 - 5. Waterflow switches.
 - 6. Valve supervisory switches.
 - 7. Piping.
 - 8. Sprinkler heads.
 - a. 1.2 SYSTEM DESCRIPTION

- B. The sprinkler system shall be an automatic fire sprinkler system supplied by a pressurized water supply (Municipal water main) to fusible sprinkler heads for the control of fire.
- C. The sprinkler system shall be hydraulically designed to meet the more stringent of the requirements of the 2013 Edition of NFPA 13.
- D. Work shall be installed in accordance with NFPA 13 and Owner's direction. Devices and equipment shall be listed by Underwriters' Laboratories, Inc. or Factory Mutual-approved, individually and as a system, as applicable.
- E. Coordinate the location of sprinkler heads and piping such that it does not interfere with the installed ceiling configuration or other building construction and equipment.

1.3 HYDRAULIC CALCULATIONS

- A. A. Prepare hydraulic calculations in accordance with NFPA 13 and with the following exceptions:

1. 1. Provide a minimum safety factor of 10 psi (68.95 kPa) on all hydraulically calculated sprinkler systems.
- B. B. Hydraulic calculations shall be performed by a State of Texas Licensed Responsible Managing Employee (RME) in the direct employ of the fire protection contractor, or by a Texas State Registered Professional Engineer (P.E.).
 1. C. A recent fire flow test shall be the basis for the fire sprinkler design.

1.4 SUBMITTALS

- A. A. Contractor's Qualification Data: Copies of fire sprinkler firm's TDI registration, RME License and Liability Insurance.
 1. B. Product Data: For each type of product indicated.
 2. C. Shop Drawings: Submit 3 (three) full-size sets of shop drawings for review. Plans must include the following:
 1. A "Wet" RME or Texas Professional Engineer's signature and stamp, is required on all plan drawings and calculations.
 2. Plans shall be clear and legible and all sheets shall be in a common and appropriate scale;
 3. The following information shall be provided on the plans:
 - a. a. Site plan showing location of the building, all fire hydrants, fire lanes, fire department connections and the fire service main location.
 - b. b. Scale.
 - c. c. Floor plan.
 - d. d. Square footage.
 - e. e. Location of doors.
 - f. f. Intended use of each room is identified.
 - g. g. North arrow provided.
 - h. h. Location of the Fire Department Connection (FDC).
 - i. i. Occupancy classification.
 - j. j. Scope of Work.
 - k. k. Equipment List.
 - l. l. Hydraulic calculations for each design area.
 - m. m. A complete full-height cross section of the building.
 - n. n. Area of coverage of each sprinkler head.
 - o. o. Total area protected by each system.
 - p. p. Capacity of the dry system or antifreeze system.
 - q. q. Hydraulic node symbols and schedule.
 - r. r. Indicate all Riser Nipples (RN) or Drop Nipples (DN).
 - s. s. Elevations of sprinkler lines and node points.
 - t. t. Hanger details.
 - u. u. Hanger locations.
 - v. v. Sprinkler riser diagram.
 - w. w. Inspectors test connection detail.
 - x. x. Auxiliary drain details.
 - y. y. Size and location of standpipe hose stations, if applicable.
 - z. z. Description of the design area.
 - aa. aa. Design density of each design area.
 - bb. Clearly indicate each remote area.
 - cc. Provide graphic representation of the waterflow analysis.
 - dd. Provide the water supply test information.
 - ee. Provide notes to indicate the following;
 - ff. Design code.
 - gg. Responsible party with regards to freeze protection. If to be provided by others, indicate and provide drawings to indicate the heaters with your submittal.

6. 4. The title block shall contain the following;
 - a. Location of the installation.
 - b. Name and complete address of the business.
 - c. Name and complete address of the installing company.
 - d. Licensing information.
 - e. Date.
 - f. Drawn by.
7. 5. A legend shall be provided to include:
 - a. Symbol, sprinkler description, manufacturer, model number, and quantity for each device.
 - b. Pipe and fittings type.
- B. Submit 3 (three) copies of equipment specification booklets containing all materials, equipment and products that are being provided for installation.
 1. Materials, equipment and products being used shall be identified in the specification booklets by an arrow or highlighter.
- C. Field test reports and certifications for compliance with performance requirements shall be submitted to the owner. Include "Contractor's Material and Test Certificate for Aboveground Piping"
 1. All fire system submittals shall be provided to the UNT Fire Marshal for review and approval prior to any work.
- D. G. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction including hydraulic calculations
 1. H. Welding certificates.
 2. I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13, Include "Contractor's Material and Test Certificate for Aboveground Piping."
 3. J. Field quality-control reports.
 - 1) Operation and maintenance data.
 4. Submit complete "As-Built" set of plans for each fire sprinkler and standpipe system.

1.5 QUALITY ASSURANCE

- A. A. Installer Qualifications: Specialist Firm -- The installing contractor shall specialize in the design and installation of fire sprinkler systems and shall be registered as a fire sprinkler contractor by the Texas State Board of Insurance Underwriters (TDI) and shall have in its employ, a Responsible Managing Employee (RME), licensed by the Texas State Board of Insurance Underwriters (TDI). The contractor shall have a minimum of three years of verifiable installation experience with fire sprinkler systems.
 1. 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services where needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test performed within past 90 days or less of design.
 2. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 4. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with 2013 Edition of NFPA 13.

1.6 PIPING AND FITTINGS

1. A. Piping and fittings:
2. All exposed, aboveground piping shall be minimum schedule 40 steel pipe*, no exception, conforming to ASTM A53 or ASTM A795, Type E, Grade A. Comply with applicable governing regulations and industry standards.

3. Piping and fittings for the fire main installed between the City's water utility connection and the required backflow prevention device for the fire riser shall be ASTM approved materials for potable water systems.
4. The piping system for a dry pipe system shall be schedule 40 galvanized steel.
- B. *Pipe and fittings shall be domestically manufactured by one of the manufacturers listed in the latest edition of the American Petroleum Institute (API) approved manufacturers listing.
- C. Threaded Fittings: Class 150 malleable iron, ANSI B16.3, for pipe sizes 2-inch and less.
- D. Malleable Iron Threaded Unions: ANSI B16.3, select for proper piping fabrication and service requirements including style, end connections, and metal-to-metal seats (iron, bronze, or brass), plain or galvanized as specified.
- E. Threaded Pipe Plugs: ANSI B16.14.
- F. Steel Flanges/Fittings: ANSI B16.5, including bolting, gasketing, and butt weld end connections. Fittings same thickness as pipe.
- G. Forged Steel Socket-welding and Threaded Fittings: ANSI B16.11, rated to match schedule of connected pipe.
- H. Wrought Steel Butt-welding Fittings: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns; rated to match connected pipe.
- I. Flanged Fittings: Comply with ANSI B16.5 for bolt-hole dimensioning, materials, and flange thickness.
- J. Flange Bolts: Bolts shall be carbon steel ASTM A307 Grade A hexagon head bolts and hexagonal nuts. Where one or both flanges are cast iron, furnish Grade B bolts. Cap screws utilized with flanged butterfly valves shall be ASTM A307 Grade B with hexagon heads.
- K. Flange Bolt Thread Lubricant: Lubricant shall be an anti-seize compound designed for temperatures up to 1000°F and shall be Crane Anti-Seize Thread Compound or approved equal.
- L. Saddle tap fitting are not allowed.

5.02 MISCELLANIOUS PIPING MATERIALS/PRODUCTS

- A. A. Welding Materials: Comply with ASME Boiler and Pressure Vessels Code, Section 11, Part C, for welding materials.
 1. Brazing Materials: American Welding Society, AWS A5.B, Classification B Cup-5.
- B. Gaskets for Flanged Joints: 1/16 inch (1.59 mm) thick for pipe size 10 inches (254 mm) and smaller and 1/8 inch (3.18 mm) thick for all pipe size 12 inches (304.8 mm) and larger. Pingtype shall be used between raised face flanges and full face-type between flat face flanges with punched bolt holes and pipe opening. Gaskets shall be Garlock Style 3400 compressed non-asbestos or equal.
- C. Dielectric Unions: Provide dielectric unions at all pipe connections between ferrous and nonferrous piping. Unions shall be "Delvin" as made by Pipeline Seal and Insulator Company or "EPCO" as made by Epco Sales, Inc. and shall have nylon insulation.
- D. Mechanical couplings may only be used for pipe sizes over 2-inch, to engage and lock grooved or pipe ends and to allow for some angular deflection, contraction and expansion.
 1. Couplings shall be positive lock type and shall consist of ASTM A536 ductile iron housing, c-shaped composition sealing gasket and carbon steel bolts conforming to ASTM A183.
 2. Gasket Material for wet systems shall be EPDM.
 3. Gasket material for dry pipe systems shall be silicone.
 4. All couplings shall be UL listed and approved.
 5. Provide only full flow (no-fabricated) fittings. Snap joint couplings, outlet couplings, cut-in style couplings, reducing couplings, mechanical-T style couplings, pressfit couplings, and plain end type couplings are not allowed.

6. When mechanical couplings are used, ONLY grooved type fittings and pipe shall be used, no plain end fittings or pipe. Grooved couplings and fittings shall be manufactured by Victaulic, "Firelock" or approved equivalent.
 - a. Water Flow Switches: Viking or approved equal water flow switch with adjustable retard feature. Switch shall be double-pole double-throw type and shall be rated at least 7 amperes at 125/250 volts.
 - b. Valve Supervisory Switches:
7. Provide on each valve, controlling or shutting-off sprinkler system where shown on drawings or/and on all valves required by NFPA 13, or any portion thereof.
8. Provide UL listed unit, with either one single pole double throw switch or two single pole double throw switches as required. Switch shall be compatible with installed valve for standard mounting. Manufactured by Potter Roemer No. 6220, or approved equal.
9. Sight Flow Connection: Provide acrylic sight flow connection in all test lines, conforming to NFPA 13.
- E. Pressure Gauges: Potter-Roemer Fig. No. 6240 or approved equal 3-1/2 inch (89 mm) diameter polished brass case, 1/4 inch (6.35 mm) NPT male connection, glass enclosed, 0-300 psi (2068.43 kPa) dial pressure gauges with isolation valves.
- F. All hangers and supports shall comply with NFPA 13.
- G. Fire Valve Cabinet (FVC): Where required, Potter-Roemer Fig. No. 18210, recessed fire valve cabinet consisting of 20 gauge steel cabinet with continuous hinge, re-coatable white polyester finish.
- H. Fire Department Valve (FDV): Where required, provide Potter Roemer No. 4060-D, UL Listed and FM approved 2-1/2" cast-brass angle valve with iron hand-wheel, female inlet by 2-1/2" male NST hose thread outlet, 300 pound rating, with female NST hose thread cap with pin lugs and chain.
- I. Wall Mounted Fire Department Siamese Connection: Potter Roemer No. 5785-C or approved equal, free standing, cast bronze body, with 2-1/2", UL listed, rough chrome plated body with polished chrome plated trim, caps and chains with NST hose threads.
- J. Remote Located Fire Department Connection: Where required by Owner, install free standing Potter Roemer No. 5761-5764 Body, cast bronze body with Siamese NST 2-1/2" outlets with polished chrome plated finish, with caps and chains, with NST threads.
- K. Roof Manifold: Where required, provide free standing Potter Roemer No. 5882 Body with 4065 Valves or approved equal, cast bronze body with 2-1/2" outlets with cast brass angle hose valves rated for 300 psi (2068.43 kPa) with polished chrome plated finish, with caps and chains, with NST threads.
- L. Post Indicator Valve: Where required, provide adjustable, free standing indicating post and valve, consisting of UL/ FM approved non-rising stem gate valve and indicating post. Gate valve shall have iron body with non-rising stem, bronze mounted, indicator post flange, 175 psi (1206.58 kPa) non-shock rating, flanged ends. Indicator post shall be free standing and shall have a cast iron body, plexiglass window and an 18 inch (457.2 mm) adjustment span with handle and locked and chained in open position. Manufactured by Mueller Valve No. A-2052 and Indicating Post No. A-20801, or approved equal.

PART 2 - PRODUCTS

6.01 2.1 SPRINKLERS

- A. Unless otherwise specified, sprinkler heads shall be a quick response type with standard (155°F) temperature rated fusible link, 1/2 inch (12.7 mm) orifice and a 5.6 K factor.
 1. Heads located within the air streams of heat emitting equipment and serving Elevator Machine Rooms, Elevator Shafts and Boiler Rooms shall have an intermediate (200°F) temperature rated fusible link.
 2. Install corrosion-resistant sprinkler heads where they are exposed to weather, moisture, or corrosive vapors.

3. Heads installed where they might receive mechanical injury or are less than 7 feet (213.36 cm) above the floor level shall be protected with approved guards in accordance with NFPA 13.
 4. Sprinklers in areas with suspended ceilings shall have pipe and fittings located above the suspended ceiling.
- B. Sprinkler heads shall be UL Listed and approved.
- C. Provide metal cabinet containing a stock of spare sprinkler heads of all types and ratings installed per NFPA 13.
1. Locate cabinet where temperature will not exceed 100°F.
 2. Location shall be approved by the Owner.
 3. Number of spare sprinklers shall conform to NFPA 13.
 4. Provide a sprinkler wrench in the cabinet, for each different type sprinkler head.
- D. Sprinklers shall be provided in electrical rooms unless otherwise noted on the drawings.
- E. The use of extended coverage type heads must have prior approval.
- F. The use of UL listed flexible type head assemblies are permitted.

2.2 VALVE SUPERVISORY SWITCHES

- 1) A. Contractor shall furnish and install supervisory switches. Coordinate wiring of switches with Electrical Contractor.

2.3 WATERFLOW SWITCHES

PROVIDE VIKING VSR-F OR EQUIVALENT WATERFLOW SWITCHES, WITH ADJUSTABLE RETARD FEATURE IN THE SUPPLY PIPE TO EACH ZONE FOR REMOTE ALARM. SWITCH SHALL BE DOUBLE-POLE SINGLE-THROW TYPE AND SHALL BE RATED AT LEAST 7 AMPERES AT 125/250 VOLTS.

WATERFLOW SWITCHES SHALL BE FURNISHED AND INSTALLED BY THIS CONTRACTOR AND WIRED BY FIRE ALARM OR ELECTRICAL CONTRACTOR. COORDINATE WIRING OF FLOW SWITCHES WITH APPROPRIATE CONTRACTOR.

10.01 BUILDING FIRE ALARM SYSTEM INTERFACE

1. Each zone control assembly shall provide an alarm signal output to the Building Fire Alarm System whenever there is waterflow in the zone. Coordinate with Fire Alarm Contractor.
2. Each valve which controls the flow of sprinkler system water shall be monitored by the Building Fire Alarm System. Coordinate with Fire Alarm Contractor.

2.5 SPRINKLER ALARM CHECK VALVE ASSEMBLY

- a. Provide 175 psi (1206.58 kPa) rated automatic sprinkler valve with one or two pole (as required) flow detectors, pressure switch and associated trim for a complete working system.
2. Provide products manufactured by Reliable, Viking or approved equivalent.

2.6 SPRINKLER INSPECTOR'S TEST ASSEMBLY

1. A. Provide NFPA 13 compliant UL Listed and approved sprinkler system inspector's test assembly, consisting of sight glass, tamper resistant test orifice, test and drain ball valve, rated for 300 psi (2068.43 kPa), manufactured by AGF Model 1000, or approved equal.

2.7 FREEZE PROTECTION FOR SPRINKLER PIPE SYSTEM

- a. Fire protection piping within unheated crawl spaces and attics shall be protected from freezing by one of the following methods:
2. Raychem XL-Trace®, or equivalent, listed and supervised thermostatically controlled heat-trace tape, capable of maintaining pipe temperature above 40° F., shall be installed along the pipe system and sprinkler heads per manufacturer's installation instructions; pipe shall also be insulated with minimum 1 inch (25.4 mm) thick Pittsburg Corning Foamglas®, John Manville Mico-Lok® Fiber Glass Pipe Insulation, or approved equivalent, type insulation. Where insulation is subject to damage, a metal outer jacket shall be installed

- over the insulation.
3. Provide a dry pipe sprinkler system with all necessary components to protect the sprinkler system pipe and heads located in the unheated space.
 - a. Dry sprinkler pipe to be schedule 40 galvanized steel pipe conforming to ASTM A53 or ASTM A795, Type E, Grade A.
 - b. Components shall be rated for a minimum 175 psi (1206.58 kPa) working pressure.
 - c. Dry Pipe Valve. Provide UL listed and FM approved externally resettable dry pipe valve (Viking, or approved equal) and appurtenances. Equip and connect as required by NFPA 13.
 - d. Provide water and air pressure gauges, priming water level indicator, alarm test bypass and accelerator. Include all necessary pipe fittings and accessories to provide a complete dry pipe Sprinkler System.
 - e. Provide air maintenance devices consisting of air relief valve, bypass valve, shut-off valves; low and high air pressure supervisory switches and water flow supervisory switch with 120 volt single phase power requirement and adjustable pressure rating of 14 to 60 psi (413.69 kPa), manufactured by Reliable or approved equal.
 - f. Provide a quick opening device equipped with an anti-flooding device (Viking or approved equal) for each system riser.
 - g. Provide an oil-free air compressor for dry pipe sprinkler system applications, permanently lubricated, direct drive, air filter, safety relief valve set at 50 psi (344.74 kPa), UL listed, sized to fill dry system within 30 seconds. Air compressor shall be either pipe mounted or floor mounted. Manufactured by Reliable or approved equal.

PART 3 - EXECUTION

14.01 3.1 PIPING INSTALLATION

- a. A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
2. 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction.
 - 1) Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- b. Piping and joints shall be full bore reamed, for all joint types.
 - 1) Slag shall be removed and cleaned at all welded joints.
 - 2) Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
 - 3) Install unions adjacent to each valve in pipes NPS 2" and smaller.
 - 4) Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
 - 5) Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
 - 6) Install sprinkler piping with drains for complete system drainage.
 - 7) Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
 - 8) Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
 - 9) Install hangers and supports for sprinkler system piping according to NFPA13. Comply with requirements for hanger materials in NFPA 13.
- c. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
 - 1) Fill sprinkler system piping completely with water.

14.02 PIPING INSTALLATION

1. Piping shall be concealed, except by prior approval of Owner. Install all piping parallel to or at right angles to the column lines of the building wherever possible.
2. Sprinklers in suspended ceilings shall be provided with arm over supply line.
3. C. Individual sprinkler head piping shall not connect to cross-main from the bottom or side of cross-main.
4. In electrical rooms, only sprinkler piping which serves the sprinkler heads in that room are allowed.
5. Wet sprinklers shall not be located in IT closets or rooms without prior approval of Owner. Wet sprinkler piping shall not be located in IT closets or rooms. Provide a plugged, 1 inch (25.4 mm) "T" fitting outside of and in close proximity to each IT closet location for future branch line installation.
6. Grade piping to eliminate traps and pockets and for drainage per NFPA 13. Where air pockets or water traps cannot be avoided, provide gate valves with hose connections for drainage.
7. It shall be the responsibility of the Fire Protection Contractor to coordinate electrical equipment locations with the Electrical Contractor and design the fire protection piping system such that no piping is routed over electrical equipment, unless it serves that room.
8. Changes in direction, branches, offsets etc., shall be made with standard pipe fittings. Holes in the main for branches shall be made with a hole-cutting machine and a standard "Weld-O-Let" or "Thread-O-Let" fitting used. Burning holes in the fire protection System Piping will cause that section of the piping to be cut out and replaced at the Contractor's expense.
9. Pipe shall be reamed to full pipe diameter before joining:
 - a. Screwed joints shall be made with standard pipe thread and an approved compound applied to the male thread only.
 - b. Welded joints shall be made in accordance with the procedure outlined in the ANSI piping code.
 - c. Valves and specialties shall be screwed or flanged joints.
 - d. Grooved joints shall be made in accordance with manufacturers recommendations with UL listed and approved couplings or weld-o-let connections to pipe mains shall be full bore.
 - e. Slag, etc. shall be removed.
10. Install unions or flanges at equipment connections and as indicated on the Drawings.
11. Cold-springing piping will not be permitted. Install piping with adequate support to prevent strain on the equipment and to allow for piping system expansion and contraction.
12. Welded joints on pipe runs shall be made with continuous welds and with pipe ends beveled before fabrication. Piping shall be carefully aligned prior to welding and no metal shall project within the pipe.
13. Piping shall be sized as required by applicable codes and as indicated on the Drawings.
14. Provide all test and drain lines as required by Section 8.17.4.1, of NFPA 13:
 - a. 1. Pressure gauges, signs, and other such standard appurtenances shall be furnished as required for a complete installation in accordance with NFPA 13.
 - b. 2. Provide nameplate data sign at the zone controlling valve to identify the system as a hydraulically designed system indicating the location and basis for design in accordance with NFPA 13.
 - c. Install sprinkler piping so that it can be thoroughly drained, and where practicable shall be arranged to drain at the zone drain valve. The zone drain valve shall be capable of a full discharge test without allowing water to flow onto the floor. All drips and drains shall conform to NFPA 13.
 - d. Field changes in the piping layout or pipe sizes shall not be made without the prior approval of the Owner.

3.2 CUTTING AND PATCHING

- a. General: Cut and patch walls, floors, etc., resulting from work or by failure to provide proper openings or recesses in new construction.
2. Methods of Cutting:
 - a. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Owner.
 - b. Impact-type equipment shall not be used except where specifically acceptable to the Owner.
 - c. Openings in precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled to exact size.
 - d. Restoration:
 - e. 1. All openings shall be restored to "as-new" condition for the materials involved, and shall match remaining surrounding materials and/or finishes.
 - f. Masonry:
 - 1) Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry.
 - 2) Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation.
 - 3) All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Owner.
3. Special Note: No cutting, boring, or excavating which will weaken the structure shall be undertaken. A Texas Registered Professional Engineer shall be consulted in these cases. Necessary structural repairs shall be designed by a Texas Registered Professional Engineer.

3.3 TESTS AND INSPECTIONS

- a. Inspections, examinations and tests required by the authorities or agencies specified shall be arranged and paid for by the Fire Protection Subcontractor, as necessary, to obtain complete and final acceptance of the system as installed. The certificates of inspection shall be in quadruplicate, and shall be delivered to the Owner.
- b. Fire protection piping systems shall be hydrostatically tested by the Contractor upon completion of the installation as required by NFPA 13 in the presence of the Owners Representative.
- c. The fire protection piping systems shall be hydrostatically tested per the requirements listed in NFPA 13.
- d. When hydrostatic and alarm tests have been completed and all necessary corrections made, a material and test certification shall be provided in accordance with NFPA 13.
- e. Final inspection shall include full flow testing through the inspectors test connection.
- f. Actuation of the flow switch shall occur within one minute of opening of the inspector's test valve.
- g. Final tests shall be witnessed by the Owner's Representative.
- h. Sprinkler system zone control assemblies shall be tested to demonstrate proper operation of the flow switch and valve supervisory switch.
- i. Arrange and pay for all tests and inspections required by authorities having jurisdiction.
- j. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
2. Prepare test and inspection reports.

3.3 JOINT CONSTRUCTION

- a. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- b. Install unions adjacent to each valve in pipes NPS 2" and smaller.

- c. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2" and larger end connections.
 - d. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - e. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
2. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
3. 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:
 - a. Apply appropriate tape or thread compound to external pipe threads.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
4. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance"
 - a. Article.
5. 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
 - a. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
 - b. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
6. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 PERIODIC INSPECTION SERVICE

- a. After completion of the fire protection system installation and at the beginning of the guarantee period, the Automatic Sprinkler Subcontractor shall execute the National Automatic Sprinkler and Fire Control Association, Inc., Standard Form of "Inspection Agreement", without change in the Contract amount, calling for four inspections of the fire protection system during the warranty period.
 - b. During the warranty period, inspections shall be in accordance with the Inspection Agreement, plus the following maintenance to be performed during the course of the fourth inspection:
 - c. Operation of all control valves.
 - d. Lubrication of operating stems of all interior valves.
 - e. Operation of all alarms, supervisory switches, air compressors, alarm trip switches, flow switches, and similar items.
 - f. Cleaning of alarm valves.
 - g. Lubrication of Fire Department valve hose connections.
2. The standard form of the National Automatic Sprinkler and Fire Control Association, Inc., "Report of Inspection", shall be filled out in triplicate after each inspection and the copies sent to the Owner.

3.4 VALVE AND SPECIALTIES INSTALLATION

1. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
2. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
3. Install check valve in each water-supply connection. Install double check, fire service rated backflow preventer in connection to potable-water-supply sources.

B. D. Specialty Valves:

- a. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.5 IDENTIFICATION

1. A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
 - a. 3.5 SPRINKLER AND COVER PLATE (RECESSED SPRINKLER HEADS) INSTALLATION
2. Sprinkler heads and recessed sprinkler cover plates shall be protected from damage, dirt and other deleterious materials during construction. Remove and replace any damaged sprinkler or sprinkler cover plate, or sprinklers or cover plates having any foreign material other than factory finish. Sprinkler heads and cover plates shall not be cleaned unless by a method approved by the manufacturer AND accepted by the Owner.

3.6 ESCUTCHEON INSTALLATION

A. INSTALL ESCUTCHEONS FOR PENETRATIONS OF WALLS, CEILINGS, AND FLOORS.

3.7 SLEEVE INSTALLATION

- 1) General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- 2) Sleeves are not required for core-drilled holes.
- 3) Permanent sleeves are not required for holes formed by removable PE sleeves
- 4) Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- 5) Install sleeves in new partitions, slabs, and walls as they are built.
- 6) For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint.
- 7) For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint.
- 8) For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- 9) Seal space outside of sleeves in concrete slabs and walls with grout.
- b. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.8 SLEEVE SEAL INSTALLATION

- a. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- b. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.9 IDENTIFICATION

- a. A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.10 FIELD QUALITY CONTROL

- a. Perform tests and inspections.
- b. Tests and Inspections:
 - 1) Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2) Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- 3) Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4) Energize circuits to electrical equipment and devices.
 - 5) Start and run excess-pressure pumps.
 - 6) Coordinate with fire-alarm tests. Operate as required.
 - 7) Verify that equipment hose threads are NST.
 - 8) Sprinkler system zone control assemblies shall be tested to demonstrate proper operation of the flow switch and valve supervisory switch.
 - 9) Arrange & pay for all tests and inspections required by authorities having jurisdiction.
- c. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
 - d. Prepare test and inspection reports.

3.11 PERIODIC INSPECTION SERVICE

- 1) Provide periodic inspections service after completion and Owner acceptance.
- b. This agreement shall be executed at no cost to the Owner and shall include four inspections of the entire sprinkler system during the warranty period, each with a NASFCA "Report of Inspection to the Owner". The final inspection shall include operation and lubrication of all valves, cleaning of all alarm valves and operational testing of all system Electrical and alarm components.

3.12 TRAINING

- A. A. The installation contractor shall provide a minimum of 4 hours of training for the Owner in operation and maintenance of the wet-pipe and/or dry pipe sprinkler system.

END OF SECTION

**SECTION 21 3000
FIRE PUMPS**

FIRE PUMPS

1.01 REFERENCE STANDARDS

- A. NFPA 20 - Standard for the Installation of Stationary Pumps for Fire Protection; 2025.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 448 - Centrifugal Stationary Pumps for Fire-Protection Service; Current Edition, Including All Revisions.
- D. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.02 1.1 SUMMARY

- A. A. This section addresses electric fire pump motors, fire and jockey pumps, respective related controllers and specialty accessories incorporated into a building fire sprinkler system.

1.03 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - a. Fire and jockey pump cut sheets with all pump capacities, UL/FM approval, pump characteristics, features and accessories clearly indicated. Include pump motor brand name and performance data.
 - b. Pump curves with selection point clearly indicated.
 - c. Fire and jockey pump motors must be listed for fire pump use and meet NFPA 20 standards. Provide Totally Enclosed, Fan Cooled (TEFC) fire pump motors. Provide complete motor specifications and data.
 - 1) U.S. Motor is not an acceptable motor manufacturer for fire pump motors.
 - d. Fire Pump Controller Automatic Transfer Switch and cut sheets with features and options clearly indicated, wiring diagrams, nameplate text and a written system operational sequence.
 - e. Jockey pump controller wiring diagram.
 - 2. Product Certificates: For each fire pump, from manufacturer.
 - 3. Source quality-control reports.
 - 4. Field quality-control reports.
 - 5. Operation and maintenance data.

1.04 1.3 QUALITY ASSURANCE

- 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

1.05 1.4 DELIVERY, STORAGE, AND HANDLING

- 1. Deliver pumps, controllers, automatic transfer switch, and accessories in factory-fabricate water resistant wrapping.
- 2. Handle pumps, controllers, automatic transfer switch, and accessories carefully to avoid damage to material components, enclosure, and finish.
- 3. Store pumps, controllers, automatic transfer switch, and accessories in a clean, dry space and protect from the weather.

1.06 1.5 COORDINATION

- 1. A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.01 2.1 MANUFACTURERS

1. A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 1. Fire Pump:
 - (a) S.A. Armstrong Limited.
 - (b) A-C Fire Pump Systems; a business of ITT Industries.
 - (c) Aurora.
 - (d) Peerless Pump, Inc.
 - (e) Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 - 2) Electric Fire Pump Motor:
 - (a) Lincoln
 - (b) WEG
 - (c) Marathon
 - 3) Jockey Pump:
 - (a) Grundfos.
 - (b) Goulds.
 - (c) S.A. Armstrong Limited.
 - 4) 4. Fire Pump Controller:
 - (a) Master.
 - (b) Firetrol, Inc.
 - (c) Metron.
 - (d) Torna Tech

2.02 2.2 ELECTRIC FIRE PUMP SYSTEM

1. General:
 - 1) Provide a complete and operational fire pumping system consisting of horizontal split case electric fire pump, jockey pump, combination fire pump controller/automatic transfer switch, jockey pump controller, flow testing equipment and associated components as specified and as scheduled and shown on Drawings.
 - 2) Equipment furnished and the complete installation shall be in accordance with NFPA 20. Pump and controller/automatic transfer switch shall bear the UL label.
 - 3) Refer to schedule on Drawings for pump size and design characteristics. Size of the fire pump is to be based on flow test information.
2. Fire Pump:
 - 1) Electric driven fire pump shall be a horizontal split case centrifugal type, UL Listed, FM-approved and in compliance with all requirements of NFPA 20.
 - (a) Pump shall be of bronze-fitted construction with Class 30 cast iron casing, bronze impeller, renewable bronze sleeves and bronze wear rings, packed stuffing boxes and grease lubricated ball bearings in motor.
 - (b) Pump shaft shall be high strength steel.
 - (c) Pump shaft deflection shall not exceed 0.002 inch (0.05 mm) at the stuffing boxes when operating at ± 25 percent of the best operating point.
3. Pump suction flange shall be rated for 125 psi (861.84 kPa) working pressure on inlet side and the discharge flange shall be rated for 250 psi (1723.69 kPa) working pressure.
 - (a) Fire pump shall be factory mounted on a pedestal and connected through a rigid split coupling. Motor shall have a 1.15 service factor shall be sized so as to not exceed the permissible loading limits of NFPA 20 at any point on the pump performance curve.
 - (b) Locked rotor current shall not exceed the values specified in NFPA 20.
 - (c) Each motor shall be of such capacity that at rated voltage under any pump operating condition, the full load ampere rating shall not be exceeded except as permitted by the service factor stamped on the motor nameplate.

- (d) Motors shall be compatible with the specified motor controller.
- (e) Motor electrical characteristics and capacity shall be as scheduled and shown on the Drawings.
- 4. Fire pump capacity shall be as scheduled on Drawings.
- 5. Pump shall be hydrostatically tested at 1.5 times the maximum working pressure but in no case less than 250 psig (1723.69 kPa).
- 6. Shutoff head of fire pump must exceed dead head of fire pump by 10 psi (68.95 kPa).
- 7. Accessories:
 - a. 1. Provide pump accessories per NFPA 20, including, but not limited to:
 - (a) 3/4" minimum casing overheat relief.
 - (b) 3-1/2" dial liquid filled compound suction pressure gauge.
 - (c) 3-1/2" dial liquid filled discharge pressure gauge.
 - (d) Eccentric tapered suction reducer.
 - (e) Concentric tapered discharge increaser.
 - (f) Base-mounted coupling guard.
 - (g) Fire pump accessories shall be approved for domestic water use.
 - (h) All relief drains to floor drains.
- 8. Factory Testing: Fire pump shall be factory tested and certified in accordance with NFPA 20. Certified performance test results and curves shall be delivered to the Owner for review prior to final fire pump acceptance.
- 9. Field Service: Pump supplier shall provide pump checkout, start-up, testing and adjusting of system components and shall perform field certification testing on the installed fire pump. The pump supplier shall also train the Owners Engineer in the proper operation and maintenance of the fire pump system.

2.03 2.3 FIRE PUMP CONTROLLER/AUTOMATIC TRANSFER SWITCH

- 1. A. The fire pump controller/automatic transfer switch shall be of the combined manual and automatic type, solid state reduced voltage, minimum, 100,000 amp withstand rated, full service, and UL listed and FM approved per NFPA 20 currently enforced. The fire pump controller/automatic transfer switch shall be housed in a NEMA 2 floor-mounted, non-vented enclosure, mounted on a 4" thick concrete pad, and include the following:
 - a. Isolation switch with a separate NEMA operating handle interlocked with circuit breaker.
 - b. Time delay circuit breaker set at 300 percent motor full load current with external LED supervised locked rotor protector, instant and time delay trip test switch, and external NEMA operator handle.
 - c. Differential adjustable pressure switch with energize to start relay.
 - d. Minimum run timer, 10 minutes non-adjustable, with timed out LED indicator.
 - e. POWER AVAILABLE and PHASE REVERSAL pilot lights wired to the line side of the motor starter. Indicating lights shall be long life LEDs.
 - f. Digital ammeter and voltmeter with three phase selector switch, calibrated traceable to NBS standards.
 - g. Built in alarm panel and supervisory power pilot light powered from separate reliable 120 VAC power source with lights, bell, silence button, and lamp test switch for indication of PUMP RUNNING, POWER FAILURE, PHASE REVERSAL, TRANSFER SWITCH IN EMERGENCY, ISOLATION SWITCH OPEN. A status panel for start and run demands shall also be included. All indicating lights shall be long life LEDs with lamp test feature.
 - h. START and STOP pushbuttons for manual control.
 - i. Two sets each of dry form "C" contacts for remote indication at main fire alarm panel for PUMP RUNNING, POWER FAILURE, PHASE REVERSAL, TRANSFER SWITCH IN EMERGENCY, ISOLATION SWITCH OPEN, and SUPERVISORY POWER FAILURE.
 - j. Digital paperless alarm recorder.

- k. Three non-fused control power transformers, surge protector wired to the load side of the isolation switch with short circuit protection, magnetic contactors with externally operable mechanical start mechanism, and restart delay timer.
 - l. Automatic transfer switch housed in a separate compartment of the fire pump controller. The transfer switch shall have normal power light and monitors, emergency power light and monitor, test switch, and time delays for generator start, transfer to emergency, and retransfer to normal. All control and monitor components shall be individually serviceable. Unit shall have, as a minimum, a 5 year warranty on parts and a 2 year warranty on labor.
 - m. The fire pump controller and transfer switch shall be for fire pump scheduled horsepower, UL 1008 listed, 3 phase motor, rating for highest low voltage (i.e. 208, 240, 460) available at site. Manufactured by Firetrol No. FTA1900, or approved equal by Master or Metron.
- B. The fire pump controller/ATS shall also have the following control functions:
- 1) Provide an interlock between the fire pump controller and ATS that will, when the fire pump is running, inhibit the automatic transfer switch from "TRANSFERRING-TO-NORMAL" power source as long as the fire pump is operating on the "EMERGENCY" source.
 - 2) Interlock control wiring from the Fire Pump Controller to the Fire Pump Automatic Transfer Switch shall be factory-installed.
 - (a) 2.4 FIRE PUMP WIRE
2. Electrical wiring for fire pump, jockey pump and associated controllers shall be installed by a Texas Department of Licensing and Regulations (TDLR) registered and licensed Electrical Contractor.
 3. Electrical supply conductors for the fire pump motor shall be sized according to NFPA 70 for Fire Pumps.
 4. Electrical supply conductors for the fire pump motor shall be capable of maintaining integrity and operation for a minimum of two hours under fire exposure condition. Acceptable wire is as follows:
 - 1) Lifeline ® Power Cable RHW-2 Two-Hour Fire Resistive Cable;
 - 2) VitaLink® MC Two Hour Fire Rated Power Cable.

2.04 2.5 FLOW TESTING EQUIPMENT

1. The fire pump supplier shall furnish a FM approved flow meter for testing the fire pump.
2. The flow meter shall be flanged venturi type BV as manufactured by Aeroquip, or approved equal.
3. The installing contractor shall submit approval drawings of the proposed piping layout, which shall conform to the requirements prescribed by the flow meter manufacturer.

2.05 2.6 FIRE PUMP TEST HEADER

1. Provide wall mounted ductile iron body outlet fire pump test connection, complete with polished chrome plated exposed surfaces, with plate lettered "Pump Test Connection".
2. Chrome plated brass NRS hose gate valves, with loose bonnet caps and chains, 2-1/2 inch (64 mm) gate valves with local fire department threads, back outlet, manufactured by Potter Roemer No. 5864-D-2, or approved equal.

2.06 2.7 JOCKEY PUMP

1. General: Provide a complete and operational electric driven fire jockey pump and jockey pump controller as specified herein and as scheduled and as shown on the Drawings.
2. Pump:
 - a. The jockey pump shall be a centrifugal multi-stage pump with stainless steel impeller and shaft, and cast iron base, and EPDM O-rings.
 - b. Jockey pump capacities shall be as scheduled on the Drawings.
 - c. Pumps, casings, flanges, and mechanical seals shall be rated for operation with the working pressures scheduled.

3. The jockey pump shall be mounted on a fabricated cast iron drip lip base and shall be close-coupled or flexible coupled to an energy efficient, high efficiency open drip-proof motor. Motor electrical characteristics and capacity shall be as scheduled or listed on the drawings.
4. Relief Valve: Provide the fire jockey pump with a factory-mounted bypass relief valve complete with piping. Set relief valve to relieve at a pressure of 25 psig (172.37 kPa) above design total dynamic head to prevent motor overload and system damage.
5. Jockey Pump Controller: The electric jockey pump controller shall be UL listed and NFPA 70 compliant. Unit shall include a circuit breaker, magnetic starter with overloads, 0-300 psig (2068.43 kPa) pressure switch, H-O-A selector switch, minimum run timer, dual fused control transformer, two sets of remote form "C" contacts for pump running, and a NEMA 2 enclosure, Master control Model PMC series, or Firetrol Model FTA500, or Metron.
6. Field Service: The pump supplier shall provide pump checkout, start-up, testing and adjusting of system components and shall perform field certification testing on the installed jockey pump. The pump supplier shall also train the Owners Representatives in the proper operation and maintenance of the jockey pump system.

2.07 2.8 GROUT

1. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink and recommended for interior and exterior applications.
3. Design Mix: 5000-psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

2.08 2.9 SOURCE QUALITY CONTROL

1. A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 - a. 1. Verification of Performance: Rate fire pumps according to UL 448.
2. Fire pumps will be considered defective if they do not pass tests and inspections.
3. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 3.1 EXAMINATION

1. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
2. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 3.2 INSTALLATION

1. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
2. Equipment Mounting: Install fire pumps and jockey pumps on concrete bases.
 - a. Where not otherwise indicated, install 4 inch (101.6 mm) thick concrete foundation pads for indoor floor-mounted equipment, except where direct floor mounting is allowed by prior approval.
 - b. For equipment mounted outdoors, provide concrete foundations a minimum of 6 inches (152.4 mm) above grade.
 - c. Provide reinforcing steel as recommended by the structural engineer and as detailed on the Drawings.
 - d. Pour pads on roughened floor slabs, sized so that outer edges extend a minimum of 3 inches (76.2 mm) beyond equipment. Trowel pads smooth and chamfer edges to a 1-inch bevel. Secure equipment to pads as recommended by the manufacturer.
 - e. Anchor Bolts. Furnish and install galvanized anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts shall be of the size and number recommended by the manufacturer of the equipment and shall be located by means of suitable templates. When equipment is placed on vibration isolators, the equipment

shall be secured to the isolator and the isolator secured to the floor, pad, or support as recommended by the vibration isolation manufacturer.

- 1) Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18" centers around the full perimeter of concrete base.
 - 2) For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3) Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4) Install anchor bolts to elevations required for proper attachment to supported equipment.
- f. Setting of Equipment. Provide permanent and temporary shoring, anchoring, and bracing required to make parts stable and rigid; even when such shoring, anchoring, and bracing are not explicitly called for.
- 1) Equipment must be leveled and set plumb.
3. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
 4. Support piping and pumps separately so weight of piping does not rest on pumps.
 5. Install valves that are same size as connecting piping.
 6. Install pressure gauges on fire-pump suction and discharge flange pressure-gauge tapings.
 7. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
 8. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to Electrical Contractor.
 9. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
 10. Engage a factory-authorized service representative to perform startup service.
 11. Complete installation and startup checks according to manufacturer's written instructions.

3.03 3.3 ALIGNMENT

1. Align split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
2. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
3. Align piping connections.
4. Align pump and driver shafts for angular and parallel alignment and to tolerances specified by manufacturer.

3.04 3.4 CONNECTIONS

1. Comply with requirements for piping and valves specified in Section 21 13 13, Wet-Pipe Sprinkler Systems. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to pumps and equipment to allow service and maintenance.
3. Connect relief-valve discharge to drainage piping or point of discharge.
4. Connect fire pumps to their controllers.

3.05 3.5 IDENTIFICATION

1. A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.06 3.6 FIELD QUALITY CONTROL

1. Test each fire pump with its controller as a unit.
2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including

connections.

3. Perform tests and inspections.
 - 1) 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. D. Tests and Inspections:
 - 1) After installing components, assemblies, and equipment including controller, test for compliance with requirements.
 - 2) Test according to NFPA 20 for acceptance and performance testing.
 - 3) Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4) Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 5) Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 6) Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
 - 7) Prepare test and inspection reports.
2. E. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

3.07 3.7 DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps. Coordinate training with Owner.
2. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans.

END OF SECTION

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**SECTION 22 0500
COMMON WORK RESULTS FOR PLUMBING**

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. 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. Plumbing demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe 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 in 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. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. 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.

1.04 SUBMITTALS

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

- B. In order to make the submittal review process more efficient for all parties, all MEP submittal data and shop drawings shall be reviewed on a designated "Submittal Review Day". The "Submittal Review Day" will consist of having the Engineer, General Contractor, Electrical Contractor and Mechanical HVAC Contractor review the submittals together, in the same room. The Architect and Owner's representative(s) will be invited to attend the "Submittal Review Day". Key Manufacturer's Representatives shall attend the review or be available by phone for immediate response to questions and/or comments. All submittals will be reviewed and stamped by the Engineer the same day. The Contractor is responsible for setting time and place for this review and inviting all required parties. All parties shall be given a minimum of 7 days notice prior to submittal review day.

1.05 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 Plumbing 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.

1.06 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.

1.07 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing 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 plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.08 GENERAL

- A. For Products specified by reference to an association or trade standard, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.
- B. The date of the standard is that in effect on the date of issue of Contract Documents, except when a specific publication date is specified. Obtain copies of referenced standards direct from publication source, when needed for proper performance of Work, or when required for submittal by Contract Documents.

1.09 SCHEDULE OF ABBREVIATIONS

- A. Reference standards are listed in various sections using abbreviations contained below:
 - a. AABC Associated Air Balance Council
 - 1) ABMA American Boiler Manufacturer Association
 - 2) ADC Air Diffusion Council

- 3) AGA American Gas Association
- 4) AIA American Insurance Association
- 5) AMCA Air Movement and Control Association
- 6) ANSI American National Standards Institute
- 7) ARI Air Conditioning and Refrigeration Institute
- 8) ASA Acoustical Society of America
 - (a) ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
- 9) ASME American Society of Mechanical Engineers
- 10) ASPE American Society of Plumbing Engineers
- 11) ASTM American Society of Testing and Materials
- 12) AWS American Welding Society
- 13) AWWA American Water Work Association
- 14) CTI Cooling Tower Institute
- 15) FM Factory Mutual Engineering and Research
- 16) IEEE Institute of Electrical and Electronic Engineers
- 17) IRI Industrial Risk Insurers
- 18) MSS Manufacturers Standardization Society of the Valve and Fitting Industry
- 19) MCAA Mechanical Contractor's Association of America
- 20) NEBB National Environmental Balancing Bureau
- 21) NBS National Bureau of Standards
- 22) NRCA National Roofing Contractor's Association
- 23) NEC National Electrical Code
- 24) NEMA National Electrical Manufacturers Association
- 25) NFPA National Fire Protection Association
- 26) NSF National Sanitation Foundation
- 27) OSHA Occupation Safety and Health Administration
- 28) PDI Plumbing and Drainage Institute

1.10 ELECTRICAL, PLUMBING, AND CONTROL CHARACTERISTICS OF EQUIPMENT

- A. The electrical, plumbing, and control characteristics of each item of equipment scheduled, noted and/or indicated on the plans and specifications are based on a particular manufacturer and model. While other manufacturers or models may be acceptable, it is the responsibility of the Contractor to verify that the electrical, plumbing, and controls characteristics for the equipment he proposes to provide match those indicated. In the instance where the equipment he proposes to provide has different electrical, plumbing, and controls characteristics, the Contractor AT NO COST TO THE OWNER shall provide the required electrical, plumbing, and controls characteristics required. All modifications to provide the electrical, plumbing, and control characteristics shall be coordinated by the Contractor with the Engineer.
- B. Motor controllers, except where they are to be mounted inside a motor control center or specifically identified and scheduled in Division 26 or on the drawings, shall be furnished by the M/C or P/C for installation by the E/C. Refer to Section 220513 for details.
- C. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.
- D. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.
- E. The date of acceptance by the Architect, for beneficial use by the Owner, shall be the beginning date of the warranty period.

1.11 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of each item of mechanical equipment shown on Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes to furnish will fit into the space. Shop drawings shall be prepared when required by the Architect to indicate a suitable arrangement.
- B. Install equipment in a manner to permit access to all surfaces. Install valves, motors, drives, lubricating devices, filters, and other accessory items in a position to allow removal for service without requiring the disassembly of another part.
- C. Large equipment or components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. The equipment shall be protected until all hazards of damage to the equipment are eliminated.

1.12 OPERATING AND MAINTENANCE MANUALS

- A. Manuals shall be submitted which contain the following:
- B. Description of the system provided.
 - 1. Handling, storage, and installation instructions.
 - 2. Detailed description of the function of each principal component of the systems or equipment, including necessary piping diagrams and valve identification charts.
 - 3. Operating procedures:
 - (a) Pre startup activities required.
 - (b) Startup.
 - (c) Normal operation.
 - (d) Emergency shutdown.
 - (e) Normal shutdown.
 - (f) Trouble-shooting guide.
 - 4. Maintenance:
 - (a) Complete lubrication requirements; type and source of lubricant, internal between lubrication, etc.
 - (b) Preventative and repair maintenance procedures.
 - (c) Complete spare parts list with cross reference to original equipment manufacturer part number.
 - 5. Control and alarm features:
 - (a) A schematic of all control systems.
 - (b) Control loop electric ladder diagrams and interlock diagrams.
 - (c) A list of all controller operating set points.
 - (d) A listing of all setting for alarms and shutdown system.
 - (e) Provide pump curves for all pumps.
 - (f) Provide fan curves for all fans.
 - 6. Safety and environmental considerations.
 - 7. Other data required elsewhere in the specifications.
- C. Three copies of the manuals shall be provided within sufficient time to allow for training of Owner's personnel. Submit one copy of the manuals to the Architect for review no later than 90 calendar days prior to substantial completion or building turn over, whichever comes first. Submit the remaining three corrected copies within 15 days after review set is returned to contractor. Progress payment may be withheld if this requirement is not met.
- D. The requirements for manuals apply to each package and field-fabricated operating system.
- E. The manuals shall be provided in three-ring side binders with durable plastic covers.
- F. The manuals shall contain a detailed table of contents and have tab dividers for major sections and special equipment.

- G. The Owner will not accept any training or equipment unless the maintenance manuals are received a minimum of 10 working days prior to request for Training/Turnover.

1.13 START-UP EQUIPMENT AND SYSTEMS

- A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer's start-up service (rendered by the manufacturer or his authorized representative) shall be provided.
- B. Witnessing and explanations of start-up services shall be included as part of the "Instruction of Owner's Personnel" as specified below.

1.14 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers or technicians acceptable to the Architect to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals.

1.15 AS-BUILT DRAWINGS

- A. The Contractor shall, during the progress of the job, keep a set of record prints on which he shall mark all changes. After completion of a CADD release form by the Contractor and near the conclusion of the job, the Architect will provide the Contractor with one set of AutoCAD electronic files of the Mechanical, Plumbing, and Electrical Drawings. The Contractor shall draft on these electronic files all changes made during the progress of the work and return them and one set of paper plans with the changes to the Architect as "As-Built Drawings".

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
- B. Each item of equipment furnished on this project shall have local representation. Factory authorized service, and adequate stock of repair parts. "Local" shall be defined for this purpose as within 50 miles (80.47 kilometers) of the project site.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 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.

2.03 JOINING MATERIALS

- A. Refer to individual Division 22 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 (3.18 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. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. 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.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.04 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
 - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. 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.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.05 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.06 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available 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: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) 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. 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.
- D. PVC Pipe: ASTM D 1785, Schedule 40.

2.08 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 or rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated or rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.09 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 (34.5-MPa), 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

2.10 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials used for insulation, acoustical linings, adhesives, jackets and coatings, and combinations of these materials, shall each have a flame spread rating of 25 or less, and a smoke developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA-255.

2.11 FIRESTOPPING

- A. Provide firestopping in sealing of penetrations in fire-rated construction, horizontal and vertical, including the following materials:
 1. Foam: Dow Corning Firestop silicone RTV foam, liquid component Part A (black) and liquid component Part B (off-white).
 2. Sealant: 3M 1000NS and 1003SL silicone adhesive sealant, single component, neutral cure, and non-slumping.
 3. Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by the applicator.
 4. Pre-installed (firestop devices for use with noncombustible and/or combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors, the following products are acceptable:
 - (a) Hilti CP 680P or CP 680M Cast-In Place Firestop Devices:
 - (1) Add Aerator adapter when used in conjunction with an Aerator (Solvent system)
 - (2) Add metal deck adapter kit if utilizing CP 680P or M on corrugated metal deck.
 - (3) Add height extension if utilizing CP 680P or M in concrete slabs thicker than 8".
 - (4) Add Hilti Water Module (2" up to 6") to achieve UL W-Rating
 - (5) Add Hilti TOP SEAL (1/2" up to 2") to achieve UL W-Rating
 - (b) Hilti CP 681 Tub Box Kit for use with bath tub installations.
 - (c) Hilti Toilet Flange for use with floor outlet water closets.
 - (d) Hilti coupling sleeve for use with floor, shower or general purposes drains.
 5. Post installed (firestop devices for use with noncombustible and/or combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors, the following products are acceptable
 - (a) Hilti Firestop Drop-In Device (CFS-DID) for use with noncombustible and combustible penetrants
- B. Mixes shall conform to the manufacturer's directions.

2.12 ACCESS PANELS AND DOORS

- A. Provide wall and ceiling access doors for unrestricted access to concealed valves, dampers, and other mechanical equipment items and devices.
- B. Access doors mounted in surfaces to be painted shall be Milcor Style "K" for plastered surfaces, and Style "M" for non-plastered surfaces. Style "K" doors shall be set with door flush with adjacent surfaces. Access doors mounted on tile surfaces shall be stainless steel and of similar construction to that described above. Access doors shall be not less than 12" x 12" in size.

PART 3 EXECUTION

3.01 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed unless otherwise indicated on the Drawings.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- D. Access: Access to and use of the existing facilities and site will be restricted, and shall be under the direction and control of the Owner.
- E. Disruptions: Maintain existing plumbing, heating, ventilating, air conditioning, fire protection, and other existing systems, and maintain all existing functions in service except for scheduled disruption. Where existing functions to remain in use are disrupted, they shall be fully restored after disruption, in full compliance with this Division of the Specifications for new work.
- F. Scheduling of Disruption: Seek and obtain approval two weeks in advance of event for date, starting, and duration of each required disruption.
- G. Notice of Disruption: Date, time and duration of each disruption shall be subject to the Owner's prior approval, and shall include the following information in the form of a memorandum submitted by the Contractor to the Architect for approval by the Owner:

STARTING

FACILITY/SYSTEM DATE TIME DURATION

- A. Emergency Disruptions: When circumstances preclude obtaining advance approval as specified above; make request immediately on knowledge of the requirement, and perform the work so as to cause the minimum amount of disruption, for the minimum duration.
- B. Notification: Notify the Architect and the owner immediately, by telephone and then in writing, as changes and additions to the scheduled disruption requirements become known.
- C. Duration: Complete as large a portion of the work as possible before initiating disruption and perform only that work necessary so as to minimize duration of disruption. Maintain adequate personnel, supplies, materials, equipment, tools, and other resources at job site to avoid unnecessary delay in resumption of normal service.
- D. General:
 1. Modify remove, or relocate materials and items indicated on the Drawings or required by the installation of new facilities.
 2. Remove demolition materials from the site and deliver salvage materials to destinations on the premises, as directed.
- E. Relocations:
 1. Repair and restore to good functional condition, equipment, materials and items scheduled for relocation, which are damaged during dismantling or reassembly operations.
 2. Remove carefully, in reserve order to original assembly or placement, items which are to be relocated.
 3. Protect items until relocation is complete.
 4. Clean and repair items to be relocated, and provide new materials, fittings, and appurtenances required to complete the relocations and to restore to good operating order.
 5. Perform the relocation work in accordance with applicable Sections of the Specifications, utilizing skilled workers.
- F. Relocating Devices: Remove and reinstall in locations designated by the Architect temperature control system devices, relays, piping, ductwork, equipment and other devices required for the operation of the various systems that are installed in existing-to-be-renovated construction.

5.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 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. 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.
- 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 (50.8 mm) 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 (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - (a) Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - (b) Steel Sheet Sleeves: For pipes NPS 6 (DN 150) 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 (50.8 mm) 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 (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches (152.4 mm) in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches (152.4 mm) 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 (25-mm) 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.

5.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 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.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

5.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) 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.

5.05 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 plumbing 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.

5.06 CONSTRUCTION REQUIREMENTS

- A. The Drawings and Specifications are intended to accomplish certain objectives. They show pipe and duct sizes, general routing and location, and describe the various systems. These documents describe and size equipment, its general location, usage, support and auxiliary requirements. They describe most, but not all of the materials and their usage for this project.
- B. Contract Documents do not, however, detail certain job requirements. They do not show exact layouts, locations or elevations of ducts, expansion joints, anchors, sleeves, hangers, slots, holes, outlets, inserts, elbows, fittings, thermometers, thermostats, gauges, wells, underfloor drains, sumps, or access doors. They do not show final precise locations of equipment by dimensions in most instances or manufacturer's requirements for proper installation, operation and maintenance.
- C. The exact location of each item shall be determined by reference to the project Contract Drawings, and to details, equipment drawings, and roughing-in drawings, by measurements at

the building, and in cooperation with the various trades. Minor relocations necessitated by the conditions at the site or directed by the Owner shall be made without additional cost to the Owner.

- D. Coordinate proper locations and sizes of slots, holes or openings in the building structure pertaining to this work, and for the correct location of sleeves. Place inserts to accommodate the ultimate installation of hangers in the forms, and set sleeves in forms before concrete is poured, and in masonry walls while they are under construction. Concealed lines shall be installed as required by the pace of the job to precede the general construction.
- E. Study construction documents and lay out piping work carefully in advance of fabrication and erection, in order to meet the requirements of the extremely limited spaces. Where conflicts occur, work with all involved trades and resolve the conflict prior to erection of any work in the area involved.

5.07 PAINTING

- A. Painting of plumbing 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.

5.08 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct minimum 3-1/2" concrete bases of dimensions indicated, but not less than 6 inches (152.4 mm) larger in both directions than supported unit. Provide No. 3 bars at 2' – 0" o.c. each way.
 - 2. Install No. 3 dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."
 - 8. Chamfer corners of all housekeeping pads.
 - 9. Provide necessary foundations for exterior and interior equipment pads and confirm construction of required pads with structural engineer.

5.09 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

5.10 GROUTING

- A. Mix and install grout for plumbing 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.

5.11 EXCAVATION AND BACKFILL FOR PLUMBING WORK

- A. Excavation
 - 1. General: Do not excavate for mechanical work until work is ready to proceed without delay, so that time lapse from excavation to completion of backfilling will be minimum.
 - 2. Excavate with vertical sided excavations to greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger work or other property. Where not removed, cut sheeting off at sufficient distance below finished grade to not interfere with other work.
 - 3. Width: Excavate for piping with 6" to 9" clearance on both sides of pipe, except where otherwise shown or required for proper installation of pipe joists, fittings, valves and other work. Excavate for other mechanical work to provide minimum practical but adequate working clearances.
 - 4. Depth for Direct Support: For work to be supported directly on undisturbed soil, do not excavate beyond indicated depths, and hand-excavate bottom cut to accurate elevations.
 - 5. Depth for Subbase Support: For large piping (6" pipe size and larger), tanks, and where indicated for other mechanical work, excavate for installation of subbase material in depth indicated or, if not otherwise indicated, 6" below bottom of work to be supported.
 - 6. Shoring and Bracing: Provide materials for shoring and bracing to comply with local codes and authorities having jurisdiction. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
 - 7. Excavation for Trenches:
 - (a) Dig trenches to uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 6" to 9" clearance on both sides of piping.
 - (b) Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.
 - (c) Where rock is encountered, carry excavation 6" below required elevation and backfill with 6" layer of crushed stone or gravel prior to installation of pipe.
 - (d) For piping 5" or less in nominal size, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support piping on undisturbed soil.
 - (e) For piping 6" and larger in nominal size, tanks, and other mechanical work indicated to receive subbase, excavate to subbase depth indicated, or if not otherwise indicated, to below bottom of work to be supported.
 - (f) Grade bottoms of trenches as indicated, notching under piping couplings to provide solid bearing for entire body of piping.
 - (g) Depth for Exterior Piping: Except as otherwise indicated, excavate for exterior piping so that depth of cover shall be 18" minimum.
 - (h) Excavate near large trees (within drip line) by hand, and protect root system from damage or dryout to greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with asphaltic tree paint.
 - (i) Store excavated material (temporarily) near excavation, in manner that will not interfere with or damage excavation or other work. Do not store under

trees (within drip line). Retain excavated material that complies with requirements for backfill material. Dispose of excavated material that is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material.

B. Backfill

1. Do not backfill until installed mechanical work has been tested and accepted, wherever testing is indicated.
2. Backfill with finely-graded subbase material to 6" above wrapped, coated, and plastic piping and tanks, and to centerline of other tanks.
3. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to required densities. Do not backfill with frozen soil materials.
4. Backfill simultaneously on opposite sides of mechanical work, and compact simultaneously; do not dislocate work from installed positions.
5. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (% of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment.
6. Lawn and Landscaped Areas: 85% for cohesive soils; 90% for cohesionless soils.
7. Paved Areas Other Than Roadways: 90% for cohesive soils; 95% for cohesionless soils.
8. Roadways: 90% for cohesive soils; 95% for cohesionless soils.
9. Backfill to elevations matching adjacent grades, at a time of backfilling excavations for mechanical work.

C. Performance and Maintenance

1. Subsidence: Where subsidence is measurable or observable at mechanical work excavations during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

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**SECTION 22 0513
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Section includes controllers (starters and variable frequency controllers) to be furnished by M/C or P/C.

1.03 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (100584 cm) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class B.
- J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers:
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.06 MOTORS AND DRIVES

- A. Motors intended for operation on 208-volt feeders shall be selected for satisfactory operation at 200 volts (phase-to-phase), and the 200-volt rating shall appear on the motor nameplates.
- B. Totally-enclosed fan-cooled (TEFC) motors shall be designed for a service factor of 1.00 and a 75 deg. C temperature rise above 40 deg. C ambient temperature at full load. Insulation shall be Class B.
- C. Provide motors with adequately sized electrical connection boxes for attachment of liquid-tight flexible conduit, and line terminals and lugs for attachment of copper cables sized in accordance with NEC. Where required, provide motors connected so as to drive equipment by the use of V-belt drives with adjustable rails.
- D. Provide motors 15-hp and larger with frame grounding lugs.
- E. Except where motors are direct-connected to the driven equipment, provide flexible couplings, or a V-belt drives of sizes and numbers of belts, and sizes and types of driving and driven sheaves as recommended by the manufacturer. Provide belt-driven equipment supplied with motors 10-hp and smaller with adjustable motor sheaves selected for approximate midpoint of the range in each instance.

2.07 CONTROLLERS

- A. Furnish a controller (starter or variable frequency drive) for each motor, except where the controller is for a motor in an integrated motor starter enclosure (such as a "Motor Control Center") specified in Division 26, and the controller within the enclosure is properly identified and is scheduled or otherwise described on the Drawings.
 - 1. Controllers shall be furnished by the M/C, P/C or mechanical equipment manufacturer. Deliver to the E/C for installation.
 - 2. Coordinate purchasing of motor starters so that, insofar as is practical, all motor starters on the project shall be products of the same manufacturer.
- B. Manufacturer of Motor Starters: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. subsidiary.
 - 2. Square D.
 - a. Standard VFD manufacturers acceptable for UNT are ABB and Square D. Exceptions have to be approved.
- C. Manufacturers of Variable Frequency Controllers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 - 2. Square D.
 - a. Standard VFD manufacturers acceptable for UNT are ABB and Square D. Exceptions have to be approved.
- D. Manual Across-the-Line Controller: Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."
 - 1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.
- E. Magnetic Across-the-Line Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
 - 1. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
 - 2. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 20 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - 3. Accessories shall include HOA switch, pilot lights and two NO 2 NC auxiliary contacts. Additional accessories are required to perform the sequence of operation for each piece of equipment.
- F. Combination Magnetic Across-the Line Controller: Factory-assembled combination controller and disconnect switch.
 - 1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
 - 2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
 - 3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- G. Variable Frequency Controllers
 - 1. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.

- a. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.
2. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
3. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
4. Unit Operating Requirements:
 - a. Input ac voltage tolerance of 208 V, plus or minus 5 or 380 to 500 V, plus or minus 10 percent.
 - b. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
 - c. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - d. Minimum Displacement Primary-Side Power Factor: 96 percent.
 - e. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
 - f. Starting Torque: 100 percent of rated torque or as indicated.
 - g. Speed Regulation: Plus or minus 1 percent.
5. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
 - a. Electrical Signal: 4 to 20 mA at 24 V.
 - b. Pneumatic Signal: 3 to 15 psig (103.42 kPa).
6. Internal Adjustability Capabilities:
 - a. Minimum Speed: 5 to 25 percent of maximum rpm.
 - b. Maximum Speed: 80 to 100 percent of maximum rpm.
 - c. Acceleration: 22 seconds minimum to 1800 seconds maximum.
 - d. Deceleration: 22 seconds minimum to 1800 seconds maximum.
 - e. Current Limit: 50 to a minimum of 110 percent of maximum rating.
7. Self-Protection and Reliability Features:
 - a. Input transient protection by means of surge suppressors.
 - b. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
 - c. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class 20 performance.
 - d. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 - e. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - f. Loss-of-phase protection.
 - g. Reverse-phase protection.
 - h. Short-circuit protection.
 - i. Motor overtemperature fault.
8. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.
9. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
10. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
11. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
12. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow

- speeds.
13. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
 - a. Power on.
 - b. Run.
 - c. Overvoltage.
 - d. Line fault.
 - e. Overcurrent.
 - f. External fault.
 14. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
 15. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
 - a. Output frequency (Hz).
 - b. Motor speed (rpm).
 - c. Motor status (running, stop, fault).
 - d. Motor current (amperes).
 - e. Motor torque (percent).
 - f. Fault or alarming status (code).
 - g. PID feedback signal (percent).
 - h. DC-link voltage (VDC).
 - i. Set-point frequency (Hz).
 - j. Motor output voltage (V).
 16. Control Signal Interface:
 - a. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
 - b. Pneumatic Input Signal Interface: 3 to 15 psig (103.42 kPa).
 - c. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
 - 1) 0 to 10-V dc.
 - 2) 0-20 or 4-20 mA.
 - 3) Potentiometer using up/down digital inputs.
 - 4) Fixed frequencies using digital inputs.
 - 5) RS485.
 - 6) Keypad display for local hand operation.
 - d. Output Signal Interface:
 - 1) A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
 - (a) Output frequency (Hz).
 - (b) Output current (load).
 - (c) DC-link voltage (VDC).
 - (d) Motor torque (percent).
 - (e) Motor speed (rpm).
 - (f) Set-point frequency (Hz).
 - e. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - 1) Motor running.
 - 2) Set-point speed reached.
 - 3) Fault and warning indication (overtemperature or overcurrent).
 - 4) PID high- or low-speed limits reached.
 17. Communications: Provide an RS485 interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.

18. Manual Bypass: Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).
19. Bypass Controller: NEMA ICS 2, full-voltage, nonreversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
20. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.
21. Isolating Switch: Non-load-break switch arranged to isolate VFC and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
22. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
23. Accessories: Provide accessories to perform the sequence of operation described for each piece of equipment.

PART 3 EXECUTION

3.01 INSTALLATION OF CONTROLLERS

- A. All controllers, except those specifically identified otherwise, shall be furnished by the M/C or P/C and installed by the E/C.

END OF SECTION

**SECTION 22 0516
EXPANSION FITTINGS AND LOOPS FOR PLUMBING 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. Rubber expansion joints.
 - 2. Flexible-hose expansion joints.
 - 3. Pipe bends and loops.
 - 4. Alignment guides and anchors.

1.03 DEFINITIONS

- A. BR: Butyl rubber.
- B. Buna-N: Nitrile rubber.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. CSM: Chlorosulfonyl-polyethylene rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. NR: Natural rubber.

1.04 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide 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. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 - 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.01 EXPANSION JOINTS

- A. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
 - 1. Arch Type: Single or multiple arches.
 - 2. Spherical Type: Single or multiple spheres.

- a. Minimum Pressure and Temperature Ratings for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1034.21 kPa) at 220 deg F (104 deg C).
 - b. Minimum Pressure and Temperature Ratings for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (965.27 kPa) at 200 deg F (93 deg C).
 - c. Minimum Pressure and Temperature Ratings for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (965.27 kPa) at 180 deg F (82 deg C).
3. Material: BR.
 4. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
- B. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
1. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder-joint end connections.
 - a. NPS 2 (DN 50) and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig (3102.64 kPa) at 70 deg F (450 psi (3100 kPa) at 21 deg C) and 340 psig (2344.22 kPa) at 450 deg F (339 psi (2340 kPa) at 232 deg C) ratings.
 - b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig (2068.43 kPa) at 70 deg F (300 psi (2070 kPa) at 21 deg C) and 225 psig (1551.32 kPa) at 450 deg F (225 psi (1550 kPa) at 232 deg C) ratings.

2.02 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

2.03 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 1. Stud: Threaded, zinc-coated carbon steel.
 2. Expansion Plug: Zinc-coated steel.
 3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
 1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 3. Washer and Nut: Zinc-coated steel.
- F. Concrete: Portland cement mix, 3000 psi (20684.28 kPa) minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 EXECUTION

3.01 EXPANSION-JOINT INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.02 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.03 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.04 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

3.05 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

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**SECTION 22 0519
METERS AND GAGES FOR PLUMBING 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 RELATED SECTIONS

- A. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
- B. Refer to Section 230519, "Meters and Gages for Piping Systems," for required products on plumbing systems.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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**SECTION 22 0523
GENERAL-DUTY VALVES FOR PLUMBING 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 angle valves.
 - 2. Bronze ball valves.
 - 3. Iron, single-flange butterfly valves.
 - 4. High performance butterfly valves.
 - 5. Bronze swing check valves.
 - 6. Iron swing check valves.
 - 7. Iron swing check valves with closure control.
 - 8. Bronze gate valves.
 - 9. Iron gate valves.
 - 10. Bronze globe valves.
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing 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 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.05 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME 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.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

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, grooves, and weld ends.
 - 3. Set angle, gate, 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 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 (DN 200) and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 6 (DN 150) 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-inch (50-mm) stem extensions and the following features:
1. Gate Valves: With rising stem.
 2. 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.
 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Grooved: With grooves according to AWWA C606.
 3. Solder Joint: With sockets according to ASME B16.18.
 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE ANGLE VALVES

- A. Class 150, Bronze Angle Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. NIBCO INC.
 - c. Powell Valves.
 - d. Milwaukee.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig (2068.43 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded or solder.
 - e. Stem: Bronze.

- f. Disc: TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

2.03 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. NIBCO INC.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - d. Apollo (manufactured by Conbraco).
 - e. Milwaukee
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1034.21 kPa).
 - c. CWP Rating: 600 psig (4136.86 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends:
 - 1) Plumbing piping: Threaded or solder.
 - 2) Chilled-water piping: Threaded or Press-Fit
 - 3) Hot-water heating piping (max temperature of 160°F): Threaded or Press-Fit
 - 4) Hot-water heating piping (max temperature above 160°F): Threaded
 - g. Seats: TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.04 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Crane Co.
 - c. Apollo (manufactured by Conbraco).
 - d. Milwaukee
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig (1378.95 kPa).
 - 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: Aluminum bronze or EPDM rubber encapsulated disc with polymer-coated body.

2.05 HIGH-PERFORMANCE BUTTERFLY VALVES

- A. Class 150, Single-Flange, High-Performance Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Crane Co.

- c. NIBCO INC.
- d. Milwaukee
- 2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig (1965.01 kPa) at 100 deg F (38 deg C).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Carbon steel.
 - h. Service: Bidirectional.

2.06 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. NIBCO INC.
 - c. Apollo (manufactured by Conbraco).
 - d. Milwaukee
 - 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig (2068.43 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: TFE.

2.07 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. NIBCO INC.
 - c. Powell Valves.
 - d. Apollo (manufactured by Conbraco).
 - e. Milwaukee
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1378.95 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze. (Renewable and regrindable disc.)
 - g. Gasket: Asbestos free.

2.08 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Crane.
 - c. Powell.

- d. Apollo (manufactured by Conbraco).
- e. Milwaukee
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1378.95 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze. (Renewable and regrindable disc.)
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and spring.

2.09 BRONZE GATE VALVES

- A. Class 150, RS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. NIBCO INC.
 - c. Powell Valves.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Apollo (manufactured by Conbraco).
 - f. Milwaukee
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig (2068.43 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded or solder.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.10 IRON GATE VALVES

- A. Class 125, OS&Y, Iron Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. NIBCO INC.
 - c. Powell Valves.
 - d. Apollo (manufactured by Conbraco).
 - e. Milwaukee
 - 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig (1378.95 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.
- B. Class 250, OS&Y, Iron Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.

- b. NIBCO INC.
- c. Powell Valves.
- d. Apollo (manufactured by Conbraco).
- e. Milwaukee
- 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 500 psig (3447.38 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.11 BRONZE GLOBE VALVES

- A. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. NIBCO INC.
 - c. Apollo (manufactured by Conbraco).
 - d. Powell Valves.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Milwaukee
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig (2068.43 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded or solder.
 - e. Stem: Bronze.
 - f. Disc: TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

- E. Install three (3) chainwheels on operators for butterfly and gate valves NPS 3 (DN 75) and larger and more than 72 inches (1828.8 mm) above floor. Extend chains to 60 inches (1524 mm) above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

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, butterfly, gate, or plug valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service except steam: Globe, angle, or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with nonmetallic disc.
 - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
 - c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- 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 (DN 50) 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 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
 - 7. For Grooved-End Steel Piping except steam and steam condensate: Valve ends may be grooved.

3.05 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (150 PSI (1035 KPA)) OR LESS)

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 3. Bronze Swing Check Valves: Class 150, nonmetallic disc.
 - 4. Bronze Gate Valves: Class 150.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 - 2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze disc.
 - 3. Iron Swing Check Valves: Class 125, metal seats.
 - 4. Iron Gate Valves: Class 125.

3.06 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 150, nonmetallic disc.
 3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
 5. Bronze Gate Valves: Class 150, RS.
 6. Bronze Globe Valves: Class 150, nonmetallic disc.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 2. Iron Ball Valves: Class 150.
 3. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze disc.
 4. Iron Swing Check Valves: Class 125, metal seats.
 5. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
 6. Iron Gate Valves: Class 125, OS&Y.

3.07 CHILLED-WATER , HOT WATER AND CONDENSER WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 150, nonmetallic disc.
 3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
 5. Bronze Gate Valves: Class 150, RS, bronze.
 6. Bronze Globe Valves: Class 150, nonmetallic disc.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 2. Iron Ball Valves, NPS 2-1/2 to NPS 10 (DN 65 to DN 250): Class 150.
 3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, NBR seat, aluminum-bronze disc.
 4. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24 (DN 350 to DN 600): 150 CWP, NBR seat, aluminum-bronze disc.
 5. Iron Swing Check Valves: Class 125, metal seats.
 6. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring.
 7. Iron Gate Valves: Class 125, OS&Y.

3.08 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG (15 PSI (104 KPA)) OR LESS)

- A. Pipe NPS 2 (DN 50) and Smaller:
1. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 2. Bronze Swing Check Valves: Class 150, nonmetallic disc.
 3. Bronze Globe Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 2. High-Performance Butterfly Valves: Class 150, single flange.
 3. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring.

3.09 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG (15 PSI (104 KPA))))

- A. Pipe NPS 2 (DN 50) and Smaller:
1. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 2. Bronze Swing Check Valves: Class 150, bronze disc.
 3. Globe Valves: Class 125, bronze, bronze disc.

- B. Pipe Sizes NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 - 2. High-Performance Butterfly Valves: Class 150, single flange.
 - 3. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring.

3.10 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 2. Bronze Swing Check Valves: Class 150, nonmetallic disc.
 - 3. Bronze Globe Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 - 2. High-Performance Butterfly Valves: Class 150, single flange.
 - 3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.

3.11 VALVES, GENERAL

- A. Each valve shall be appropriately rated, as to pressure and temperature, for the fluid being handled by the system and for the operating pressure anticipated at the valve location.
- B. Where ball valves, plug valves and butterfly valves are installed in piping to be insulated, provide extended type operators/stems to points beyond the exterior surface of the insulation.
- C. Provide chain operators on gate valves and butterfly valves 3-inch and larger mounted higher than six (6) feet above the floor.
- D. Valve Standardization: Valves from one or more manufacturers may be used, however valves supplied for each specific valve type shall be the product of one manufacturer.
- E. Valves shall be first quality, free from all imperfections and defects, with body markings indicating manufacturer and rating.
- F. Valve parts of same manufacturer, size and type shall be interchangeable.
- G. Manually operated gate, globe and angle valves shall be of rising stem type, unless otherwise specified.
- H. Manually operated valves shall open in a counterclockwise direction by means of round ventilated type handwheels.
 - 1. Exception: Cross handle type handwheels are acceptable for valves up to 2 inches (50.8 mm) in size.
- I. In open position, wedge and stem of gate valves shall clear the waterway completely.
- J. Valves that use packing shall be capable of being packed when wide open and under full working pressure.
- K. All valves that use packing shall utilize non-asbestos materials.
- L. Size valves the same size as the piping in which they are installed, unless otherwise specified.

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**SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

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. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener 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 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
 - 3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 4. Division 22 Section "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.03 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."

1.04 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.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Pipe positioning systems.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." 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 D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.01 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. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.02 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.

2.03 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.04 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Insulation-Insert Material: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50.8 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.05 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

2.07 ROOF PIPING SUPPORTS

- A. Piping located on roofs shall be supported using devices with polypropylene or poly carbonate bases. The bases shall have integral cradles to support piping, or roller devices as called for on the drawings. The quantity and size of supports shall be such that the weight on the roofing membrane shall not exceed 2 psi (13.79 kPa).
- B. Roof supports shall be manufactured by Miro Industries or PHP Systems/Design.

PART 3 EXECUTION

3.01 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 copper-plated hangers and supports or 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 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN 100 to DN 400), requiring up to 4 inches (101.6 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches (101.6 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN 15 to DN 600), if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), 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 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
 - 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 (DN 10 to DN 200).
 - 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN 10 to DN 80).
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 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 (DN 100 to DN 900), 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 (DN 100 to DN 900), 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 (DN 65 to DN 900), 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 (DN 25 to DN 750), 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 (DN 65 to DN 500), 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 (DN 50 to DN 1050), 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 (DN 50 to DN 600), 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 (DN 50 to DN 750), 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 (DN 20 to DN 500).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), 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 (152.4 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) 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): 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-joint 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 (340 kg).

- b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
- 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. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. 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 (32 mm).
 - 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.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.
- P. Select size of hangers and supports to exactly fit pipe size and insulation.

3.02 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. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping. All hangers on domestic water and hydronic piping shall be installed on the exterior of the pipe insulation.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (101.6 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Provide pipe hangers at every elbow and any change in direction per MSS-SP-58.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. 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.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. 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 (DN 65) 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.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Hangers shall be installed on the exterior of pipe insulation. Use thermal-hanger shield insert with clamp sized to match OD of insert.

- b. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) 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 (DN 8 to DN 90): 12 inches (304.8 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (304.8 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457.2 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (609.6 mm) long and 0.075 inch (1.9 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (609.6 mm) long and 0.105 inch (2.67 mm) thick.
 5. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
 6. Insert Material: Length at least as long as protective shield.
 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
 8. Hangers for cold piping shall be placed around the outside of the insulation/vapor barrier or insulation must completely cover the hanger and rod.
- Q. Do not use wire or perforated metal to support piping, and do not support piping from other pipes.
- R. Support fire protection piping independently from other piping.

3.03 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 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.

3.05 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 (38 mm).

3.06 INSTALLATION OF ROOF SUPPORTS

- A. Install pre-manufactured pipe supports to elevate piping to a height indicated on the drawings. The maximum load across the base of supports shall not exceed 2 psi (13.79 kPa). Support piping so it is level along the full length.

3.07 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 (0 inch (0.05 mm)).
- 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

SECTION 22 0548
VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

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.
- B. Refer to Vibration Controls for HVAC Piping and Equipment, Section 230548, for plumbing vibration controls.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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**SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

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. Equipment labels.
 - 2. Pipe labels.
 - 3. Valve tags.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.04 COORDINATION

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

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.18 mm) thick, and having predrilled holes for attachment hardware.
 - 2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 4. Minimum Letter Size: 1/4 inch (6.35 mm) for name of units if viewing distance is less than 24 inches (609.6 mm), 1/2 inch (12.7 mm) for viewing distances up to 72 inches (1828.8 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 5. Fasteners: Stainless-steel rivets or self-tapping screws.
- B. Label Content: Include equipment's Drawing designation or unique equipment number.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.03 VALVE TAGS

- A. Valve Tags: Stainless Steel or Brass labels for mechanical engraving and having chain for attachment to valve.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 EXECUTION

3.01 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.02 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 20 feet (609.6 cm) along each run. Reduce intervals in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color:
 1. Provide labels of standard accepted color schemes for each plumbing and mechanical system on the project.

3.03 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Identify valve locations above ceilings with red 1/2" square or round press-tape markers at ceiling access panels.

END OF SECTION

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**SECTION 22 0700
PLUMBING 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:
 - 1. Insulation Materials:
 - a. Flexible elastomeric
 - b. Mineral fiber.
 - 2. Factory-applied jackets.
 - 3. Field-applied jackets.
- B. Related Sections include the following:
 - 1. Division 23 Section "HVAC Insulation."

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. LEED Submittal:
 - 1. Product Data for Credit IEQ-Low-Emitting Materials: For adhesives and sealants, including printed statement of VOC content.

1.04 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting 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.

1.05 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.

1.06 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.
- C. Coordinate installation and testing of heat tracing.

1.07 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 Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. 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.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials (0.25Btu in/h ft² at 75 degrees Fahrenheit (23.89 degrees Celsius)).
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. 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(Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ (0.24 Btu in/h ft² at 75 degrees Fahrenheit (23.89 degrees Celsius)). Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.03 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 PVC Corporation; LoSmoke.
 - 2. Color: Refer to color chart on Plumbing Notes sheet per UNT Guidelines.
 - 3. 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.
 - 4. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) 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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 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. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (101.6 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 2 inches (50.8 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer 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 (101.6 mm) 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 (50.8 mm) 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 (50.8 mm).
 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 Division 07 Section "Penetration Firestopping" and fire-resistant joint sealers.
 2. Provide UL-approved assemblies.
- 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 Division 07 Section "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 and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. 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, vessels, and equipment. 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 (50.8 mm) 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 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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.

3.07 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (152.4 mm) o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 (25.4 mm), 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.

3.08 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are required, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (304.8 mm) o.c. and at end joints.

3.09 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified on Plumbing sheets as UNT Guidelines.
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. Do not field paint aluminum or stainless-steel jackets.

3.10 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.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold and Non-Circulated Hot Water:
 1. NPS 1-1/4 (DN 25) and Smaller: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (12.7 mm) thick.
 2. NPS 1-1/2 (DN 32) and Larger: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25.4 mm) thick.
- B. Domestic Circulated Hot Water:
 1. NPS 1-1/4 and Smaller: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25.4 mm) thick.
 2. NPS 1-1/2 and Larger: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch (38 mm) thick.
- C. Stormwater and Overflow:
 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25.4 mm) thick.
- D. Roof Drain and Overflow Drain Bodies:
 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25.4 mm) thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1/2 inch (12.7 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (12.7 mm) thick.
- F. Sanitary Waste Piping Where Heat Tracing Is Installed:
 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.
- G. Condensate and Equipment Drain Water:
 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1/2 inches (12.7 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (12.7 mm) thick.
- H. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water:
 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25.4 mm) thick.
- I. Below Grade Domestic Hot Water:
 1. All Pipe Sizes: Insulation shall be:
 - a. Flexible Elastomeric: 1-1/2 inch (38 mm) thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50.8 mm) thick.
- B. Domestic Hot and Recirculated Hot Water:
 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50.8 mm) thick.
- C. Sanitary Waste Piping Where Heat Tracing Is Installed:
 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50.8 mm) thick.
- D. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25.4 mm) thick.
- E. Hot Service Vents:
 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type II: 1 inch (25.4 mm) thick.

3.13 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. Equipment, Exposed, up to 48 Inches (47.24 inch (1200 mm)) in Diameter or with Flat Surfaces up to 72 Inches (70.87 inch (1800 mm)):
 1. PVC, Color by UNT Guidelines, 20 mils (0.02 inch (0.5 mm)) thick.
- D. Indoor Piping, Exposed:
 1. PVC, Color by UNT Guidelines, 20 mils (0.02 inch (0.5 mm)) thick.
- E. Exterior Piping, Exposed:
 1. Aluminum, Corrugated: 0.032 inch (0.81 mm) thick.

3.14 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

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**SECTION 22 1116
DOMESTIC WATER 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. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.
 - 4. Water meters.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Wall penetration systems.

1.03 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Dielectric fittings.
 - 3. Flexible connectors.
 - 4. Backflow preventers and vacuum breakers.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
- B. LEED Submittal:
 - 1. Product Data for Credit IEQ-Low-Emitting Materials: For solvent cements and adhesive primers, including printed statement of VOC content.
- C. : Detail, at 1/4" = 1'-0" scale, the major overhead piping layout, locations of valves and other pieces of equipment, elevation of piping, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints, attachments of the same to building structure, equipment supports and foundations, underground piping layout. Out-of-scale drawings showing actual dimensions will not be acceptable. Shop drawings shall show coordination with all other building trades.

1.04 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.05 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Architect's written permission.

1.06 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88 water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. 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.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - a. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - b. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- B. Soft Copper Tube: ASTM B 88 water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - b. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.03 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.18 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, Grade Sb-5, lead-free alloys. Include water-flushable flux according to ASTM B 813. 95% tin/5% antimony solid, string or wire type (cored solder will not be allowed).
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.04 PEX TUBE AND FITTINGS

- A. Uponor PEX piping for domestic cold/hot water use. NO EXCEPTIONS on manufacturer.
- B. Tube Material: PEX plastic according to ASTM 876.
- C. Fittings: ASTM F 1960, cold expansion fittings and reinforcing rings.

2.05 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.06 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:

1. Description:
 - a. Pressure Rating: 150 psig (1034.21 kPa) at 180 deg F (82 deg C).
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig (1034.21 kPa).
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.07 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig (1378.95 kPa).
 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig (1378.95 kPa).
 2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.08 WATER METERS

- A. Displacement-Type Water Meters:
 1. Description:
 - a. Standard: AWWA C700.
 - b. Pressure Rating: 150-psig (1035-kPa) working pressure.
 - c. Body Design: Nutating disc; totalization meter.
 - d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility.
 - e. Case: Bronze.
 - f. End Connections: Threaded.
 - g. Control: Provide connection to BMS.

2.09 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- C. Split Plate, Stamped Steel: Chrome-plated finish with hinge, setscrew.
- D. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.10 SLEEVES

- A. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- C. 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 setscrews.

2.11 WALL PENETRATION SYSTEMS

- A. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.

2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
3. Housing-to-Sleeve Gasket: EPDM rubber.
4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
5. Pipe Sleeve: AWWA C151, ductile-iron pipe.

PART 3 EXECUTION

3.01 EARTHWORK

- A. Comply with requirements in Division 22 Section "Common Work Results for Plumbing" and Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- F. Install domestic water piping level and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. 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.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping adjacent to equipment and specialties to allow service and maintenance.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- Q. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- S. Install PEX tubing with a loop at each change of direction more than 90 degrees.

- T. Joints for PEX Tubing: Join according to ASTM F 1960 for cold expansion fittings and reinforcing rings.

3.03 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.04 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (9.52 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1524 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1828.8 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2438.4 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches (2743.2 mm) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (304.8 cm) with 1/2-inch (13-mm) rod.
 - 6. NPS 6 (DN 150): 10 feet (304.8 cm) with 5/8-inch (16-mm) rod.
- E. Install supports for vertical copper tubing every 10 feet (304.8 cm).
- F. Install vinyl coated hangers for PEX tubing at a maximum horizontal spacing of 32 inches (812.8 mm).
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.07 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- C. Install sleeves in new partitions, slabs, and walls as they are built.
- D. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- E. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- F. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- G. Seal space outside of sleeves in concrete slabs and walls with grout.
- H. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.08 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.09 FIELD QUALITY CONTROL

- A. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

- b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Piping Tests:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 4. Cap and subject piping to static water pressure of 50 psig (344.74 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and for corrective action required.
- C. Domestic water piping will be considered defective if it does not pass tests and inspections.
- D. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

- A. Clean and disinfect potable and non-potable domestic water piping as follows:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets, or four (4) hours minimum.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.

- 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets, or four (4) hours minimum.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Compile and maintain cleaning reports and make available to the AHJ, owner, architect and engineer as needed.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building service piping, NPS 4 (DN 80) and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K, wrought-copper solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, NPS 4 (DN 100) and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and soldered joints.
 - a. Per UNT Design Guidelines, mechanical joints are preferred.
 - 2. For piping NPS 2 and below the contractor may use PEX tubing with ASTM F 1960 cold expansion fittings and reinforcing rings. PEX is not allowed on vertical risers, only horizontal runs. Refer to insulation requirements on drawings/specifications, per IECC 2015, all PEX piping (hot and cold) is still required to be insulated the same as copper.

3.13 SCHEDULE OF BRANCHES

- A. The sizes of branches or runouts to each fixture shall be as indicated on the drawings. Where no size of connection is indicated, connections shall be no smaller than those indicated in the following schedule:

FIXTURE	COLD WATER	HOT WATER
Water Closets	1"	---
Lavatories	1/2"	1/2"
Urinals	3/4"	---
Sinks	1/2"	1/2"
Service Sinks	3/4"	3/4"
Hose Bibbs	3/4"	---
Box Hydrants	3/4"	---
Elec. Water Cooler	1/2"	---

Showers	1/2"	1/2"
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3.14 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION

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**SECTION 22 1119
DOMESTIC WATER 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. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Water hammer arresters.
 - 10. Trap-seal primer valves.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 22 Section "Domestic Water Piping" for water meters.

1.03 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (861.84 kPa), unless otherwise indicated.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 PRODUCTS

2.01 VACUUM BREAKERS

- A. Vacuum Breakers:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Watts Industries, Inc.; Water Products Div. – Model No. 288-AC.
 - b. Conbraco Industries, Inc.
 - c. MIFAB, Inc.
 - d. Woodford Manufacturing Company.
 - e. Zurn Plumbing Products Group
 - 2. Standard: ASSE 1011.

3. Finish: Chrome plated.

2.02 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group
 2. Standard: ASSE 1013.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 12 psig (82.74 kPa) maximum, through middle 1/3 of flow range.
 5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 7. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Double-Check Backflow-Prevention Assemblies:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 4. Pressure Loss: 5 psig (34.47 kPa) maximum, through middle 1/3 of flow range.
 5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 7. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

2.03 WATER PRESSURE-REDUCING VALVES

- A. Water Regulators:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Industries, Inc.; Water Products Div.

- e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig (1034.21 kPa).
4. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

2.04 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 2. Type: Y-pattern globe valve with two readout ports and memory setting indicator.
 3. Body: Bronze,
 4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.05 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Leonard Valve Company.
 - e. Powers; a Watts Industries Co.
 - f. Symmons Industries, Inc.
 - g. Taco, Inc.
 - h. Watts Industries, Inc.; Water Products Div.
 - i. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1070.
 3. Pressure Rating: 125 psig (861.84 kPa).
 4. Type: Thermostatically controlled water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Threaded union inlets and outlet.
 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Valve Finish: Rough bronze.
- B. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Leonard Valve Company.
 - b. Powers; a Watts Industries Co.

- c. Symmons Industries, Inc.
2. Description: Factory-fabricated, cabinet-type, thermostatically controlled, water-mixing-valve assembly in two-valve parallel arrangement.
3. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
4. Small-Flow Parallel: Thermostatic water mixing valve.
5. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
6. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
7. Component Pressure Ratings: 125 psig (861.84 kPa) minimum, unless otherwise indicated.
8. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
9. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.
10. Piping Finish: Copper.

2.06 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 1. Pressure Rating: 125 psig (861.84 kPa) minimum, unless otherwise indicated.
 2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
 3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers NPS 3 (DN 75) and Smaller: 0.062 inch (1.57 mm).
 - b. Strainers NPS 4 and larger: 0.125 inch (3.18 mm).
 6. Drain: Factory-installed, hose-end drain valve.
 7. Schedule: Mueller #352 for 150 psig (1034.21 kPa) and less.

2.07 HOSE BIBBS

- A. Hose Bibbs:
 1. Standard: ASME A112.18.1 for sediment faucets.
 2. Body Material: Bronze.
 3. Seat: Bronze, replaceable.
 4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 6. Pressure Rating: 125 psig (861.84 kPa).
 7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 9. Finish for Service Areas: Rough bronze.
 10. Finish for Finished Rooms: Chrome or nickel plated.
 11. Include operating key with each operating-key hose bibb.
 12. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.08 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Woodford Manufacturing Company – Model B65.
 - b. Josam Company.
 - c. MIFAB, Inc.

- d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- e. Tyler Pipe; Wade Div.
- f. Watts Drainage Products Inc.
- g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig (861.84 kPa).
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.

2.09 GROUND HYDRANTS

- A. Nonfreeze Ground Hydrants:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Woodford Manufacturing Company – Model Y-70.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.21.3M.
 3. Type: Nonfreeze, concealed-outlet ground hydrant with box.
 4. Operation: Loose key.
 5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
 6. Inlet: NPS 3/4 (DN 20).
 7. Outlet: Garden-hose thread complying with ASME B1.20.7.
 8. Drain: Designed with hole to drain into ground when shut off.
 9. Box: Standard pattern with cover.
 10. Box and Cover Finish: Polished nickel bronze.
 11. Operating Key(s): One with each ground hydrant.
 12. Vacuum Breaker: ASSE 1011.

2.10 WATER HAMMER ARRESTERS

- A. Water Hammer Arresters:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- g. Tyler Pipe; Wade Div.
- h. Watts Drainage Products Inc.
- i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER VALVES

- A. Supply-Type, Trap-Seal Primer Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam – Model No.88250.
 - b. MIFAB, Inc.
 - c. PPP Inc.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig (861.84 kPa) minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
 4. Install between 3'-0" and 5'-0" above finished floor.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

- H. Install ground hydrants with 1 cu. yd. (0.75 cu. m) of crushed gravel around drain hole. Set ground hydrants with box flush with 12" x 12" x 6" concrete pad. Provide a backflow preventer in piping supplying each hydrant.
- I. Install water hammer arresters in water piping according to PDI-WH 201.
- J. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.
- C. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.04 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

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SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - 2. Vertically mounted, in-line, close-coupled centrifugal pumps.
- B. Related Sections include the following:
 - 1. Division 22 Section "Domestic-Water Packaged Booster Pumps" for booster systems.

1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 1. When pumps are connected to VFD's, the submittal shall include an equipment selection with pump curves for both the optimized impeller trim, and the largest impeller trim available that does not allow an overload condition.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

PURDY-MCGUIRE, INC.

1. Armstrong Pumps Inc.
 2. American-Marsh Pumps
 3. Bell & Gossett Pump; Xylem.
 4. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
 5. Pentair Pump Group; Aurora Pump.
 6. TACO Incorporated.
 7. Thrush Company, Inc.
- B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.
- C. Pump Construction:
1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
 2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
 3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
 4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
 5. Bearings: Oil-lubricated; bronze-journal or ball type.
 6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.
- E. See plans on Drawings for sizes and capacities.

2.2 VERTICALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Armstrong Pumps Inc.
 2. American-Marsh Pumps
 3. Bell & Gossett Domestic Pump; ITT Corporation.
 4. Grundfos Pumps Corp.
 5. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
 6. Peerless Pump, Inc.
 7. Pentair Pump Group; Aurora Pump.
 8. TACO Incorporated.
 9. Thrush Co. Inc.
 10. Weinman Division; Crane Pumps & Systems.
- B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted vertical.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with wear rings and threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
 2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
 3. Shaft and Shaft Sleeve: Stainless-steel shaft, with copper-alloy shaft sleeve.
 4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Bearings: Oil-lubricated; bronze-journal or ball type.
 6. Shaft Coupling: Flexible or rigid type if pump is provided with coupling.
- D. Motor: Single speed, with grease-lubricated ball bearings; and rigidly mounted to pump casing.
- E. See plans on Drawings for sizes and capacities.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Motor controllers, except where they are to be mounted inside a motor control center or specifically identified and scheduled in Division 26 or on the drawings, shall be furnished by the P/C for installation by the E/C. Refer to Section 220513 for details.

2.4 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
1. Type: Water-immersion temperature sensor, for installation in piping.
 2. Range: 50 to 125 deg F.
 3. Enclosure: NEMA 250, Type 4X.
 4. Operation of Pump: On or off.
 5. Transformer: Provide if required.
 6. Power Requirement: 120 V, ac.
 7. Settings: Start pump at 105 deg F and stop pump at 120 deg F.
- B. Timers: Electric, for control of hot-water circulation pump.
1. Type: Programmable, seven-day clock with manual override on-off switch.
 2. Enclosure: NEMA 250, Type 1.suitable for wall mounting.
 3. Operation of Pump: On or off.
 4. Transformer: Provide if required.
 5. Power Requirement: 120 V, ac.
 6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install horizontally mounted, in-line, close-coupled centrifugal pumps with shaft(s) horizontal.
- D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.
- E. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using elastomeric pads. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
- F. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.
1. Comply with requirements for hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- G. Install thermostats in hot-water return piping.
- H. Install timers on wall in engineer's office.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping:
 - 2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Division 22 Section "Domestic Water Piping Specialties."

3.4 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set thermostats and timers for automatic starting and stopping operation of pumps.
 - 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 7. Start motor.
 - 8. Open discharge valve slowly.
 - 9. Adjust temperature settings on thermostats.
 - 10. Adjust timer settings.

3.6 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

**SECTION 22 1316
SANITARY WASTE, STORM DRAINAGE, AND VENT PIPING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AASHTO M 252 - Standard Specification for Corrugated Polyethylene Pipe, 75- to 250-mm (3- to 10-in.) Diameter; 2024.
- B. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter; 2021.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sump Pumps."

1.04 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (4 psi (30 kPa)).
 - 2. Storm drainage piping: 10-foot head of water (4 psi (30 kPa)).
 - 3. Storm drainage, force-main piping: 50 psig (344.74 kPa).

1.05 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. LEED Submittal:
 - 1. Product Data for Credit IEQ-Low-Emitting Materials: For solvent cements and adhesive primers, including printed statement of VOC content.
- C. Shop Drawings:
 - 1. Detail, at 1/4" = 1'-0", the major overhead piping layout, locations of drains and cleanouts, elevation of piping, equipment supports and foundations, underground piping layout. Out-of-scale drawings showing actual dimensions will not be acceptable. Shop drawings shall show coordination with all other building trades.

1.06 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.
- C. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed with NSF International.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to,

manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.04 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Solvent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: ASTM C 1540, with stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

2.05 PVC PIPE AND FITTINGS

- A. Solid-Wall Schedule 40 PVC Pipe: ASTM D 2665, drain, waste, and vent.
 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
 2. Pipe and fittings in paragraph and subparagraph below are available in NPS 3 to NPS 12 (DN 80 to DN 300).
- B. Solvent Cement and Adhesive Primer:
 1. Use PVC solvent cement, ASTM D 2564, that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use adhesive primer, ASTM F 656, that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. PVC piping shall not be installed in a return air plenum.
- D. PVC sewer piping and fittings if allowed by the UNT AHJ and only allow below grade.

2.06 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 1. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.07 FOUNDATION AND BELOW FLOOR PIPES AND FITTINGS

- A. Perforated PE Pipe and Fittings:
 1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated; for coupled joints.
 2. NPS 8 and Larger: ASTM F 667; AASHTO M 252, Type CP, or AASHTO M 294, Type CP; corrugated; for coupled joints.

3. Couplings: Manufacturer's standard, band type.
 4. Foundation Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent unless otherwise indicated.
- B. Encase pipe with PP or polyester fibers or combination of both, sock-style geotextile filter fabric before installing pipe. Connect sock sections with tape.
- C. Refer to Section 334600 for additional information.

PART 3 EXECUTION

3.01 EXCAVATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" and Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping (all sizes) shall be any of the following:
1. Hubless cast-iron soil pipe and fittings; standard couplings; and hubless-coupling joints.
- C. Aboveground, vent piping, all sizes, shall be any of the following:
1. Hubless cast-iron soil pipe and fittings; standard couplings and hubless-coupling joints.
- D. Underground, soil, waste, and vent piping, all sizes, shall be any of the following:
1. Service weight, cast-iron soil piping; gaskets; and gasketed joints.
 2. Solid-wall SCH 40 PVC pipe and fittings. (*except where noted on the drawings*)
- E. Aboveground storm drainage piping (all sizes), shall be any of the following:
1. Hubless cast iron soil pipe and fittings; standard, shielded stainless steel couplings, and coupled joints.
- F. Underground storm drainage piping (all sizes) shall be any of the following:
1. Service weight, cast iron soil pipe and fittings; gaskets and gasketed joints.
 2. Solid-wall SCH 40 PVC pipe and fittings.

3.03 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary and storm sewers as indicated, and:
1. As required by the plumbing code.
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 74 or AWWA C105.
- F. Make changes in direction for soil, storm and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install storm soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain and Horizontal Sanitary Drainage Piping: 1/4" per foot where possible, and not less than 1/8" per foot.
 - 2. Vent Piping: 1/8" per foot down toward vertical fixture vent or toward vent stack.
 - 3. Building Storm Drain and Horizontal Storm Drain Piping: 1/8" per foot in direction of flow.
- I. All underground piping will have a minimum earth cover of 36" to the top of the pipe.
- J. All underground piping systems will have a #12 AWG copper wire attached to the pipe for a tracing wire. Wire is to be labeled and terminated in an accessible location. No splicing of wire is allowed. This is required by UNT Guidelines.
- K. labeled and terminated in an accessible location. No splices in wire allowed.
- L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- M. Install PVC storm, soil and waste drainage and vent piping according to ASTM D 2665.
- N. Install underground PVC storm, soil and waste drainage piping according to ASTM D 2321.
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2855.

3.05 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
 - 2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.

4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.06 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet (30 m), if indicated: MSS Type 49, spring cushion rolls.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1524 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 60 inches (1524 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1524 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 (DN 150): 60 inches (1524 mm) with 3/4-inch (19-mm) rod.
 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1524 mm) with 7/8-inch (22-mm) rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet (457.2 cm).
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4 (DN 32): 72 inches (1828.8 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2438.4 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 (DN 65): 108 inches (2743.2 mm) with 1/2-inch (13-mm) rod.
 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (304.8 cm) with 1/2-inch (13-mm) rod.
 5. NPS 6 (DN 150): 10 feet (304.8 cm) with 5/8-inch (16-mm) rod.
 6. NPS 8 (DN 200): 10 feet (304.8 cm) with 3/4-inch (19-mm) rod.
- H. Install supports for vertical copper tubing every 10 feet (304.8 cm).
- I. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1219.2 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 48 inches (1219.2 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and 5 (DN 100 and 125): 48 inches (1219.2 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 (DN 150): 48 inches (1219.2 mm) with 3/4-inch (19-mm) rod.
 5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1219.2 mm) with 7/8-inch (22-mm) rod.
- J. Install supports for vertical PVC piping every 48 inches (1219.2 mm).
- K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

3.08 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary and storm drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (4 psi (30 kPa)). From 4 hours before inspection starts or more to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.
- E. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.09 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 SCHEDULE OF BRANCHES

FIXTURE	WASTE	VENT	COLD WATER	HOT WATER
Water Closets	4"	2"	1"	--
Lavatories	2"	1-1/2"	1/2"	1/2"
Urinals	2"	1-1/2"	3/4"	--
Sinks	2"	1-1/2"	1/2"	1/2"
Service Sinks	3"	2"	3/4"	3/4"
Hose Bibbs	---	---	3/4"	---
Box Hydrants	---	---	3/4"	---
Elec. Water Cooler	2"	1-1/2"	1/2"	---
Showers	2"	2"	1/2"	1/2"

END OF SECTION

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**SECTION 22 1319
SANITARY WASTE AND STORM DRAINAGE 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. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Channel drainage systems.
 - 5. Interceptors.
 - 6. Roof drains.
 - 7. Conductor nozzles.

1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Floor drains and sanitary waste accessories.
 - 2. Interceptors.
 - 3. Storm drainage accessories.

1.05 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.06 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.01 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Standard: ASME A112.14.1.
 - 2. Size: Same as connected piping.
 - 3. Body: Cast iron.

4. Cover: Cast iron with threaded access check valve.
 5. End Connections: Hub and spigot or hubless.
 6. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
 7. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
1. Size: Same as floor drain outlet.
 2. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 3. Check Valve: Removable ball float.
 4. Inlet: Threaded.
 5. Outlet: Threaded or spigot.
- C. Horizontal, Plastic Backwater Valves:
1. Size: Same as connected piping.
 2. Body: PVC.
 3. Cover: Same material as body with threaded access to check valve.
 4. Check Valve: Removable swing check.
 5. End Connections: Socket type.

2.02 CLEANOUTS

- A. Exposed Metal Cleanouts:
1. Standard: ASME A112.36.2M for cast iron.
 2. Size: Same as connected drainage piping
 3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch, Hubless, cast-iron soil pipe test tee as required to match connected piping.
 4. Closure: Countersunk, cast-iron, plastic plug.
 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 6. Closure: Stainless-steel plug with seal.
- B. Metal Floor Cleanouts
1. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
 2. Size: Same as connected branch.
 3. Type: Threaded, adjustable housing.
 4. Body or Ferrule: Cast iron.
 5. Closure: Brass plug with straight threads and gasket, Plastic plug.
 6. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 7. Frame and Cover Shape: Round.
 8. Top Loading Classification: Medium Duty.
- C. Cast-Iron Wall Cleanouts:
1. Standard: ASME A112.36.2M. Include wall access.
 2. Size: Same as connected drainage piping.
 3. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 4. Closure: Countersunk, drilled-and-threaded brass plug.
 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.03 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.6.3.
 3. Body Material: Cast iron.
 4. Refer to the schedule on the Drawings for further requirements regarding strainers, finishes, backwater valves, sediment buckets, loading, funnels and trap primers. All drains shall be fully adjustable and have deep seal traps.
- B. Trap Guards:
 1. Pre-manufactured devices inserted in the floor drain or opening to prevent sewer gases from entering the space or backwater.
 2. Device is constructed of elastomeric material that bends and opens to allow water to flow through it and closes when there is no water flow.
 3. ProVent Systems, Inc. "trapguard" or equal.

2.04 CHANNEL DRAINAGE SYSTEMS

- A. Polymer-Concrete Channel Drainage Systems:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABT, Inc.
 - b. ACO Polymer Products, Inc.
 - c. Forte Composites, Inc.
 - d. Josam Company; Mea-Josam Div.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Watts Drainage Products Inc.
 2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.
 - 1) Dimensions: 4-inch (102-mm) inside width. Include number of units required to form total lengths indicated.
 - 2) Frame: Gray-iron or galvanized steel for grates.
 - b. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: Cast iron.
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 - c. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - d. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.05 INTERCEPTORS

- A. Grease, Oil, and Solids Interceptors:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.

- e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.14.3, for intercepting and retaining fats, oils, and greases from food-preparation wastewater.
3. Plumbing and Drainage Institute Seal: Required.
4. Body Material: Cast iron or steel.
5. Interior Lining: Corrosion-resistant enamel.
6. Exterior Coating: Corrosion-resistant enamel.
7. Refer to schedule on Drawings for size, capacity, flow rate and mounting details for each type of interceptor.

2.06 ROOF DRAINS

- A. Metal Roof Drains:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.21.2M.
 3. Pattern: Roof drain.
 4. Body Material: Cast iron.
 5. Combination Flashing Ring and Gravel Stop: Required.
 6. Outlet: Bottom.
 7. Dome Material: Cast iron.
 8. Extension Collars: Required.
 9. Underdeck Clamp: Required.
 10. Sump Receiver: Required.
 11. Overflow Drains: Provide exterior water dam – 2" high.

2.07 MOTORS

- A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.08 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Downspout Boots:
 1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop-applied bituminous coating.
 2. Size: Inlet size to match downspout.
 3. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
 4. Size: Same as or larger than connected downspout.
- B. Conductor Nozzles:
 1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
 2. Size: Same as connected conductor.

PART 3 EXECUTION

3.01 CONCRETE BASES

- A. Anchor interceptors to concrete bases.
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch (480-mm) centers around full perimeter of base.

2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.02 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet (1524 cm) for piping NPS 4 (DN 100) and smaller and 100 feet (3048 cm) for larger piping.
 4. Locate at base of each vertical soil and waste stack.
 5. Confirm all locations with Architect prior to installation.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Where cleanouts occur flush with floor, they shall be designed for the type and finish of floor material. Confirm floor finish with Architect prior to installation.
- G. Cleanout coverplates shall be attached with vandal-proof screws.
- H. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (29.53 inch (750 mm)) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 59.06 inch (1500 mm)): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (59.06 inch (1500 mm)) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- I. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- J. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

- K. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- L. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- M. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- N. Assemble open drain fittings and install with top of hub 2 inches (50.8 mm) above floor.
- O. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- P. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- Q. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- R. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- S. Install vent caps on each vent pipe passing through roof.
- T. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- U. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- V. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- W. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- X. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Division 23 Section "Facility Fuel-Oil Piping."
- Y. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- Z. Install wood-blocking reinforcement for wall-mounting-type specialties.
- AA. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- BB. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- CC. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
 - 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.

- DD. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- EE. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- FF. Install manufactured, gray-iron downspout boots at grade with top 6 inches (152.4 mm)] (5.98 inch (152 mm)), (12.01 inch (305 mm)) above grade. Secure to building wall.
- GG. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.05 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

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SECTION 22 3100 - DOMESTIC WATER SOFTENERS

PART 1 - GENERAL

Plumbing Contractor is responsible to furnish, install and execute all of the following work as required, specified and/or indicated on plan unless noted to be performed by another contractor.

1.1 SUMMARY

- A. This Section includes commercial water softeners.
 - 1. Commercial Water Softeners
 - 2. Water testing kits.
- B. Materials covered by this Section are to be purchased directly from the supplier unless noted otherwise. This contractor shall review and adjust shop drawings as necessary, coordinate shipping dates, receive products on the job site, store the product until installation and shall install the product as if it had been purchased by the contractor.

1.2 SUBMITTALS

- A. Product Data: For each type of water softener and water testing kit indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and connections to piping systems.
 - 1. Include wiring diagrams.
 - 2. Include rated capacities, operating characteristic, electrical characteristics, and furnished specialties and accessories.
- C. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softener that fails in materials or workmanship within specified warranty period.
 - 1. Water Softener, Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 1. Basis of Design
 - a. Water Control Corporation (1-866-405-1268 or techsupport@watercontrolinc.com)
- 2. Approved Equal

2.2 COMMERCIAL WATER SOFTENERS

- A. Description: Factory-assembled, pressure-type water softener.
 - 1. Manufacturers: WCC (Water Control Corporation).
 - 2. Comply with NSF 61, "Drinking Water System Components--Health Effects."

3. Model: LF-150-MR progressive/metered water softening system.
4. Configuration: 1 mineral tank(s) and 1 brine tank.
5. Mineral Tanks: Fiberglass, electric welded; pressure-vessel quality.
 - a. Construction: Fiberglass reinforced polyester, reinforced with a continuous roving glass filament overwrap. Tanks shall have a molded polypropylene base for support. Non- ASME code.
 - b. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
 - c. Distribution System: Hub and lateral type distributor system with PVC riser; fabricated from PVC pipe and fittings with individual, fine-slotted, non-clogging PE strainers; arranged for even flow distribution through resin bed.
6. Control: Fully automatic; factory mounted on unit and factory wired, electronic controller for programmable variable on demand mode which brings unit on and off depending on service flow.
 - a. Control valves shall be of all brass construction, multi-port for maximum flow, and have 2" NPT inlet/outlet connections.
 - b. Control valves shall be motor driven, mechanically activated design with five positions to accomplish the regeneration steps of backwash, brine and rinse, rapid rinse, brine refill, and service.
 - c. Control valves shall be fitted with a brine injector assembly, and a self-adjusting backwash flow control.
 - d. Control system will display status of each tank with respect to service and regeneration.
 - e. Controller shall progressively bring additional units on and off-line, as needed, to maintain flow rates and reduce risk of channeling.
 - f. Softening system shall include 2" meters located on the outlet side of each softener control.
 - g. System shall be programmed so units are unable to regenerate simultaneously.
 - h. Pressure Rating: 150 psig maximum.
 - i. Wetted Components: Suitable for water temperatures from 34 to at least 110 deg F.
7. Brine Tank: Combination measuring and wet-salt storing system.
 - a. Tank and Cover Material: Fiberglass, 3/16 inch thick; or molded PE, 3/8 inch thick.
 - b. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill.
 - c. Size: Large enough for at least four regenerations at full salting.
8. Warranty: 1 Year.

B. Additional Options:

1. Brine Reclaim: System shall include brine reclaim system components for the recovery/reuse of brine water.
 - a. Drain line and brine tank solenoid valves (120 VAC, 1ph) shall be electrically-actuated, pre-wired for connection to softener control valves, and built with chloride-resistant plastic or 316SS wetted components.
 - b. Control valves and solenoid valves shall be pre-programmed to achieve a minimum 25% brine water usage reduction, with complete emptying of brine tank during each regeneration cycle.
2. Pre-plumbed Manifold: System to include pre-plumbed piping manifold, with inlet, outlet, bypass, drain line outlet, and (if applicable) Brine Reclaim connections.
 - a. Manifold piping material: Copper
 - b. Manifold inlet/outlet pipe size: 2"
 - c. Manifold pipe joining method Copper Press
 - d. Manifold to include isolation valves and meters for each individual softener valve.
 - e. Manifold to include full-sized system bypass with bypass isolation valve.
 - f. Manifold to include temporary pipe supports, to be installed onsite. Temporary pipe supports will require onsite modifications per the actual site requirements. Permanent

piping supports shall be supplied, and installed by the installing contractor, per local code requirements.

3. System skid: Softener tanks and pre-plumbed piping manifold to be mounted on, and secured to, heavy-duty, powder-coated steel skid base.
 - a. Brine tank location: On skid
4. Brine tank and Bulk Salt Storage System designed to receive bulk salt deliveries via pneumatic delivery system.
 - a. Tank and Cover Material: 3/8" thick molded (high density) polyethylene. Approximate tank size 24" dia x 50" high. Brine tank shall be sized as required for salt delivery approximately once a month.
 - b. Other Components: Internal brine collector, filter bag(cover), automatic air check, gasketed salt platform and grid assembly.
 - c. Service Tap Enclosure: Surface mount at location shown on plans, Full 316 stainless steel, 29" wide x 12" high x 6" deep, with 2" female PVC fill connection internal and include a hinged cover and key-lock mechanism. Coordinate mounting in existing wall at reasonable height for ready access by delivery personnel. Field coordinate location of door and pipe route.
 - d. Fill Piping: 2" 316 Stainless steel piping from wall outlet to the tank, any required elbows shall be a long sweep 316 stainless steel (for reduced friction). PVC pipe and fittings will not be accepted.
 - a. Anchor piping to structure at 5' intervals with metallic full circumference pipe trapeze anchors. Stainless, or Copper.
 - b. All elbows on the installation shall be electronically grounded.

Capacity and Characteristics:

2. Service: Cold and hot water.
3. Pressure: 30 – 125 psi
4. Temperature: 34 - 110F
5. Continuous Service Flow Rate: 44 gallons per minute continuous at a 15 psi drop.
6. Peak Service Flow Rate: 60 gallons per minute peak at a 25 psi drop.
7. Minimum Service Flow Rate: 32 GPM at 7 psi drop.
8. Water Consumption: 1750 gal. /day.>
9. Water Demand: 8 hours/day (adj.)
10. Number of Mineral Tanks: [1]
11. Mineral Quantity, Each Tank: [5] cu. ft.
12. Mineral Exchange Capacity: [150000] grains/per tank.
13. Electrical Characteristics:
 - a. Volts: 120.
 - b. Phases: 1.
 - c. Hertz: 60.
 - d. Full-Load Amperes: 3.5
 - e. Minimum Circuit Ampacity:
 - f. Maximum Overcurrent Protection: 5
14. Salt Capacity: [625] lbs salt.

2.3 CHEMICALS

- A. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.
 1. Exchange Capacity: 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb. (6.8 kg) of salt.
- B. Salt for Brine Tanks: High-purity sodium chloride; free of dirt and foreign material. Rock and

granulated forms are not acceptable.

1. Form: Processed, food-grade salt pellets.

PART 3 - EXECUTION

3.1 WATER SOFTENER INSTALLATION

- A. Install commercial water softener equipment, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.
- B. Install brine lines and fittings furnished by equipment manufacturer.
- C. Field installs mineral-tank distribution system and under bed for minerals and place specified mineral into mineral tanks as furnished by equipment manufacturer.
- D. Install flow meters furnished by equipment manufacturer and install in copper piping to softener per manufacturer's installation instructions.
- E. Mount softener controller in accessible location for programming and monitoring system.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections between water-softener-unit headers and dissimilar-metal water piping with dielectric fittings. Dielectric fittings are specified in Division 22 Section "Common Work for Plumbing."
- D. Install shutoff valves and unions on raw-water inlet and soft-water outlet piping of each mineral tank, and on inlet and outlet headers.
 1. Metal general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing."
- E. Install drains as indirect wastes to spill into floor sink.
- F. Ground equipment according to Division 26 Section "Grounding and Bonding."
- G. Connect wiring according to Division 26 Section "Conductors and Cables."
- H. Install pressure gauges on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gauges are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."
- I. Install Sampling ports.
- J. Install a vacuum break between the softener and the potential cause of a vacuum anytime a vacuum situation may occur.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning water softeners that do not pass tests and inspections and retest as specified above.

3.4 STARTUP SERVICE

- A. The Plumbing Contractor is responsible to complete and sign the "Request for start-up" checklist attached and return to Water Control Corporation.
- B. The Plumbing Contractor is responsible to add water to brine tanks and fill with salt.
 - 1. Commercial Water Softeners: Plain salt pellets – 625 lbs.

END OF SECTION

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SECTION 223400 - FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following fuel-fired water heaters:
 1. Commercial, power-burner, recirculating, gas water heaters.
 2. Commercial, high-efficiency, gas water heaters.
 3. Compression tanks.
 4. Water heater accessories.

1.3 DEFINITIONS

- A. LP Gas: Liquefied-petroleum fuel gas.

1.4 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASHRAE/IESNA 90.1: Applicable requirements in ASHRAE/IESNA 90.1.
- E. ASME Compliance:
 1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components, or complete product, of fuel-fired water heaters that fail in materials or workmanship within specified warranty period. This is considered full warranty unless specified differently below.

1. Warranty Period: From date of substantial completion:
 - a. Instantaneous, Gas Water Heaters:
 - 1) Leaks and Heat Exchanger: Parts and labor for five years.
 - 2) Controls and Other Components: Parts and labor for three years.
 - b. Commercial, Gas Water Heaters:
 - 1) Heat Exchanger, leaks, and Storage Tank: Parts and labor for three years.
 - 2) Controls and Other Components: Parts and labor for three years.

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 COMMERCIAL, GAS WATER HEATERS

- A. Commercial, Power-Burner, Recirculation, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
 1. Available Manufacturers:
 - a. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - b. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - c. Bradford White Corporation.
 - d. Precision Boilers.
 - e. PVI Industries, LLC.
 - f. RECO USA.
 - g. Smith, A. O. Water Products Company.
 2. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 3. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Powered, maintenance free.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 4. Burner: Comply with UL 795 for modulating power-burner water heaters and for natural-gas fuel.
 - a. Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
 5. Temperature Control: Adjustable thermostat.
 6. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 7. Special Requirements: NSF 5 construction.
 8. Capacity and Characteristics:
 - a. Refer to floor plans, details and schedules on Drawings.
- B. Commercial, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
 1. Available Manufacturers:
 - a. AERCO International.

- b. Bradford White Corporation.
- c. Lochinvar Corporation.
- d. Patterson-Kelley.
- e. RBI Water Heaters; a Mestek, Inc. Company.
- f. Rheem Water Heater Div.; Rheem Manufacturing Company.
- g. Smith, A. O. Water Products Company.
- h. State Industries, Inc.
- i. Ruud Water Heater Div.; Rheem Manufacturing Company.
2. Description: Manufacturer's proprietary design to provide combustion efficiency as scheduled.
3. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets. Lining shall be applied after tank has been welded and assembled.
4. Factory-Installed, Storage-Tank Appurtenances:
 - a. Power Anode Rod: Non-Sacrificial
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
5. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural-gas fuel.
6. Temperature Control: Adjustable thermostat.
7. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
8. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.
9. Capacity and Characteristics:
 - a. Refer to floor plans, details and schedules on Drawings.

2.3 COMPRESSION TANKS

- A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 1. Available Manufacturers:
 - a. AMTROL Inc.
 - b. Armstrong Pumps, Inc.
 - c. Flexcon Industries.
 - d. Honeywell Sparco.
 - e. Smith, A. O.; Aqua-Air Div.
 - f. State Industries, Inc.
 - g. Taco, Inc.
 - h. Watts Regulator Co.
 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 3. Capacity and Characteristics:
 - a. Refer to floor plans, details and schedules on Drawings.

2.4 WATER HEATER ACCESSORIES

- A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1 manually operated. Furnish for installation in piping.
- B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
- C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.
 - 1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
 - 2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.
- E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.
 - 1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
 - 2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.
- F. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
- G. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.
- H. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- I. Carbon monoxide (CO) monitoring system at the heater location to automatically shut-down heater and alarm BAS.
 - 1. Provide CO detector with a manual reset in each boiler room with greater than 200,000 BTU/h total capacity of 120 gallons of total storage.
 - 2. Interlock the CO detector and all heater(s)/boiler(s) in common room to disable the burners when the measured level of CO rises above 50 ppm.
 - 3. CO detector to disable the burners upon loss of power to the detector.
 - 4. Provide connection to BAS for alarm.

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - 2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

- C. Install gas water heaters according to NFPA 54.
- D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
- E. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
- F. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
- G. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- H. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
- J. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- K. Install pressure gage(s) on outlet piping of commercial, fuel-fired water heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- N. Fill water heaters with water.
- O. Charge compression tanks with air.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - B. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.
 - C. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.
- 3.4 DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain instantaneous and commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

**SECTION 23 0500
COMMON WORK RESULTS FOR HVAC**

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. 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. HVAC demolition.
 9. Equipment installation requirements common to equipment sections.
 10. Painting and finishing.
 11. Concrete bases.
 12. Supports and anchorages.

1.03 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.

1.04 SUBMITTALS

- A. Product Data: For the following:
 1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
- B. In order to make the submittal review process more efficient for all parties, all MEP submittal data and shop drawings shall be reviewed on a designated "Submittal Review Day". The "Submittal Review Day" will consist of having the Engineer, General Contractor, Electrical Contractor and Mechanical HVAC Contractor review the submittals together, in the same room.

The Architect and Owner's representative(s) will be invited to attend the "Submittal Review Day". Key Manufacturer's Representatives shall attend the review or be available by phone for immediate response to questions and/or comments. All submittals will be reviewed and stamped by the Engineer the same day. The Contractor is responsible for setting time and place for this review and inviting all required parties. All parties shall be given a minimum of 7 days notice prior to submittal review day.

1.05 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.

1.06 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.

1.07 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."

1.08 GENERAL

- A. For Products specified by reference to an association or trade standard, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.
- B. The date of the standard is that in effect on the date of issue of Contract Documents, except when a specific publication date is specified. Obtain copies of referenced standards direct from publication source, when needed for proper performance of Work, or when required for submittal by Contract Documents.

1.09 SCHEDULE OF ABBREVIATIONS

- A. Reference standards are listed in various sections using abbreviations contained below:
 - 1. AABC Associated Air Balance Council
 - a. ABMA American Boiler Manufacturer Association
 - b. ADC Air Diffusion Council
 - c. AGA American Gas Association
 - d. AIA American Insurance Association
 - e. AMCA Air Movement and Control Association
 - f. ANSI American National Standards Institute
 - g. ARI Air Conditioning and Refrigeration Institute

- h. ASA Acoustical Society of America
 - 1) ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
- i. ASME American Society of Mechanical Engineers
- j. ASPE American Society of Plumbing Engineers
- k. ASTM American Society of Testing and Materials
- l. AWS American Welding Society
- m. AWWA American Water Work Association
- n. CTI Cooling Tower Institute
- o. FM Factory Mutual Engineering and Research
- p. IEEE Institute of Electrical and Electronic Engineers
- q. IRI Industrial Risk Insurers
- r. MSS Manufacturers Standardization Society of the Valve and Fitting Industry
- s. MCAA Mechanical Contractor's Association of America
- t. NEBB National Environmental Balancing Bureau
- u. NBS National Bureau of Standards
- v. NRCA National Roofing Contractor's Association
- w. NEC National Electrical Code
- x. NEMA National Electrical Manufacturers Association
- y. NFPA National Fire Protection Association
- z. NSF National Sanitation Foundation
- aa. OSHA Occupation Safety and Health Administration
- bb. PDI Plumbing and Drainage Institute

1.10 ELECTRICAL, PLUMBING, AND CONTROL CHARACTERISTICS OF EQUIPMENT

- A. The electrical, plumbing, and control characteristics of each item of equipment scheduled, noted and/or indicated on the plans and specifications are based on a particular manufacturer and model. While other manufacturers or models may be acceptable, it is the responsibility of the Contractor to verify that the electrical, plumbing, and controls characteristics for the equipment he proposes to provide match those indicated. In the instance where the equipment he proposes to provide has different electrical, plumbing, and controls characteristics, the Contractor AT NO COST TO THE OWNER shall provide the required electrical, plumbing, and controls characteristics required. All modifications to provide the electrical, plumbing, and control characteristics shall be coordinated by the Contractor with the Engineer.
- B. Motor controllers, except where they are to be mounted inside a motor control center or specifically identified and scheduled in Division 26 or on the drawings, shall be furnished by the M/C or P/C for installation by the E/C. Refer to Section 220513 for details.
- C. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.
- D. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.
- E. The date of acceptance by the Architect, for beneficial use by the Owner, shall be the beginning date of the warranty period.

1.11 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of each item of mechanical equipment shown on Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes to furnish will fit into the space. Shop drawings shall be prepared when required by the Architect to indicate a suitable arrangement.

- B. Install equipment in a manner to permit access to all surfaces. Install valves, motors, drives, lubricating devices, filters, and other accessory items in a position to allow removal for service without requiring the disassembly of another part.
- C. Large equipment or components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. The equipment shall be protected until all hazards of damage to the equipment are eliminated.

1.12 OPERATING AND MAINTENANCE MANUALS

- A. Manuals shall be submitted which contain the following:
 - 1. Description of the system provided.
 - 1) Handling, storage, and installation instructions.
 - 2) Detailed description of the function of each principal component of the systems or equipment, including necessary piping diagrams and valve identification charts.
 - 2. Operating procedures:
 - 1) Pre startup activities required.
 - 2) Startup.
 - 3) Normal operation.
 - 4) Emergency shutdown.
 - 5) Normal shutdown.
 - 6) Trouble-shooting guide.
 - 3. Maintenance:
 - 1) Complete lubrication requirements; type and source of lubricant, internal between lubrication, etc.
 - 2) Preventative and repair maintenance procedures.
 - 3) Complete spare parts list with cross reference to original equipment manufacturer part number.
 - 4. Control and alarm features:
 - 1) A schematic of all control systems.
 - 2) Control loop electric ladder diagrams and interlock diagrams.
 - 3) A list of all controller operating set points.
 - 4) A listing of all setting for alarms and shutdown system.
 - 5) Provide pump curves for all pumps.
 - 6) Provide fan curves for all fans.
 - 5. Safety and environmental considerations.
 - 6. Other data required elsewhere in the specifications.
- B. Three copies of the manuals shall be provided within sufficient time to allow for training of Owner's personnel. Submit one copy of the manuals to the Architect for review no later than 90 calendar days prior to substantial completion or building turn over, whichever comes first. Submit the remaining three corrected copies within 15 days after review set is returned to contractor. Progress payment may be withheld if this requirement is not met.
- C. The requirements for manuals apply to each package and field-fabricated operating system.
- D. The manuals shall be provided in three-ring side binders with durable plastic covers.
- E. The manuals shall contain a detailed table of contents and have tab dividers for major sections and special equipment.
- F. The Owner will not accept any training or equipment unless the maintenance manuals are received a minimum of 10 working days prior to request for Training/Turnover.

1.13 START-UP EQUIPMENT AND SYSTEMS

- A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer's start-up

service (rendered by the manufacturer or his authorized representative) shall be provided.

- B. Witnessing and explanations of start-up services shall be included as part of the "Instruction of Owner's Personnel" as specified below.

1.14 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers or technicians acceptable to the Architect to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals.

1.15 AS-BUILT DRAWINGS

- A. The Contractor shall, during the progress of the job, keep a set of record prints on which he shall mark all changes. After completion of a CADD release form by the Contractor and near the conclusion of the job, the Architect will provide the Contractor with one set of AutoCAD electronic files of the Mechanical, Plumbing, and Electrical Drawings. The Contractor shall draft on these electronic files all changes made during the progress of the work and return them and one set of paper plans with the changes to the Architect as "As-Built Drawings".

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
- B. Each item of equipment furnished on this project shall have local representation, factory-authorized service and an adequate stock of repair parts. "Local" shall be defined, for this purpose, as "within 50 miles (80.47 kilometers) of the project site."

2.02 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.

2.03 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.
 - 1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - 2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.18 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. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. 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.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 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.
- 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.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

2.05 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.06 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Manufacturers:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Metraflex Co.
 - 4) Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Carbon steel or stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) 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.

2.08 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.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.09 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 (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.10 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials used for insulation, acoustical linings, adhesives, jackets and coatings, and combinations of these materials, shall each have a flame spread rating of 25 or less, and a smoke developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA-255.

2.11 FIRESTOPPING

- A. Provide firestopping in sealing of penetrations in fire-rated construction, horizontal and vertical, including the following materials:
 1. Foam: Dow Corning Firestop silicone RTV foam, liquid component Part A (black) and liquid component Part B (off-white).
 2. Sealant: 3M 1000NS and 1003SL silicone adhesive sealant, single component, neutral cure, and non-slumping.
 3. Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, and plywood or particle board, as selected by the applicator.
- B. Mixes shall conform to the manufacturer's directions.

2.12 ACCESS PANELS AND DOORS

- A. Provide wall and ceiling access doors for unrestricted access to concealed valves, dampers, and other mechanical equipment items and devices.
- B. Access doors mounted in surfaces to be painted shall be Milcor Style "K" for plastered surfaces, and Style "M" for non-plastered surfaces. Style "K" doors shall be set with door flush with adjacent surfaces. Access doors mounted on tile surfaces shall be stainless steel and of similar styles as the carbon steel access doors described above. Access doors shall be not less than 12" x 12" in size.

PART 3 EXECUTION

3.01 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping in its entirety. If a portion of piping is to remain active, plug remaining piping with same or compatible piping material.
 - 2. Ducts to Be Removed: Remove portion of duct in its entirety. If a portion of duct is to remain active, cap and seal with same or compatible ductwork material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment including housekeeping pad.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- D. Access: Access to and use of the existing facilities and site will be restricted, and shall be under the direction and control of the Owner.
- E. Disruptions: Maintain existing plumbing, heating, ventilating, air conditioning, fire protection, and other existing systems, and maintain all existing functions in service except for scheduled disruption. Where existing functions to remain in use are disrupted, they shall be fully restored after disruption, in full compliance with this Division of the Specifications for new work.
- F. Scheduling of Disruption: Seek and obtain approval two weeks in advance of event for date, starting, and duration of each required disruption.
- G. Notice of Disruption: Date, time and duration of each disruption shall be subject to the Owner's prior approval, and shall include the following information in the form of a memorandum submitted by the Contractor to the Architect for approval by the Owner:
 - 1. Facility/System Date Starting Time /Duration
- H. Emergency Disruptions: When circumstances preclude obtaining advance approval as specified above; make request immediately on knowledge of the requirement, and perform the work so as to cause the minimum amount of disruption, for the minimum duration.
- I. Notification: Notify the Architect and the owner immediately, by telephone and then in writing, as changes and additions to the scheduled disruption requirements become known.
- J. Duration: Complete as large a portion of the work as possible before initiating disruption and perform only that work necessary so as to minimize duration of disruption. Maintain adequate personnel, supplies, materials, equipment, tools, and other resources at job site to avoid unnecessary delay in resumption of normal service.
- K. General:
 - 1. Modify remove, or relocate materials and items indicated on the Drawings or required by the installation of new facilities.
 - 2. Remove demolition materials from the site and deliver salvage materials to destinations on the premises, as directed.

- L. Relocations:
 - 1. Repair and restore to good functional condition, equipment, materials and items scheduled for relocation, which are damaged during dismantling or reassembly operations.
 - 2. Remove carefully, in reverse order to original assembly or placement, items which are to be relocated.
 - 3. Protect items until relocation is complete.
 - 4. Clean and repair items to be relocated, and provide new materials, fittings, and appurtenances required to complete the relocations and to restore to good operating order.
 - 5. Perform the relocation work in accordance with applicable Sections of the Specifications, utilizing skilled workers.
- M. Relocating Devices: Remove and reinstall in locations designated by the Architect temperature control system devices, relays, piping, ductwork, equipment and other devices required for the operation of the various systems that are installed in existing-to-be-renovated construction.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- 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.
- M. Install sleeves for pipes passing through concrete and masonry walls, rated gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (152.4 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (152.4 mm) 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.
- O. 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 (25-

mm) 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.
- P. 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.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 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.
- I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom.
- 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.

3.06 CONSTRUCTION REQUIREMENTS

- A. The Drawings and Specifications are intended to accomplish certain objectives. They show pipe and duct sizes, general routing and location, and describe the various systems. These documents describe and size equipment, its general location, usage, support and auxiliary requirements. They describe most, but not all of the materials and their usage for this project.
- B. Contract Documents do not, however, detail certain job requirements. They do not show exact layouts, locations or elevations of ducts, expansion joints, anchors, sleeves, hangers, slots, holes, outlets, inserts, elbows, fittings, thermometers, thermostats, gauges, wells, underfloor drains, sumps, or access doors. They do not show final precise locations of equipment by dimensions in most instances, or manufacturer's requirements for proper installation, operation and maintenance.
- C. The exact location of each item shall be determined by reference to the project Contract Drawings, and to details, equipment drawings, and roughing-in drawings, by measurements at the building, and in cooperation with the various trades. Minor relocations necessitated by the conditions at the site or directed by the Owner shall be made without additional cost to the Owner.
- D. Coordinate proper locations and sizes of slots, holes or openings in the building structure pertaining to this work, and for the correct location of sleeves. Place inserts to accommodate the ultimate installation of hangers in the forms, and set sleeves in forms before concrete is poured, and in masonry walls while they are under construction. Concealed lines shall be installed as required by the pace of the job to precede the general construction.
- E. Study construction documents and lay out piping work carefully in advance of fabrication and erection, in order to meet the requirements of the extremely limited spaces. Where conflicts occur, work with all involved trades and resolve the conflict prior to erection of any work in the area involved.

3.07 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.

3.08 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct minimum 3-1/2" concrete bases of dimensions indicated, but not less than 4 inches (101.6 mm) larger in both directions than supported unit. Provide No. 3 bars at 2'-0" o.c. each way.
 - 2. Install No. 3 dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."
8. Chamfer corners of all housekeeping pads.
9. Provide necessary foundations for exterior equipment pads and confirm construction of required pads with structural engineer.

3.09 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 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.

3.10 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.11 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.

3.12 EXCAVATION AND BACKFILL FOR MECHANICAL WORK

- A. Excavation
 1. General: Do not excavate for mechanical work until work is ready to proceed without delay, so that time lapse from excavation to completion of backfilling will be minimum.
 2. Excavate with vertical sided excavations to greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger work or other property. Where not removed, cut sheeting off at sufficient distance below finished grade to not interfere with other work.
 3. Width: Excavate for piping with 6" to 9" clearance on both sides of pipe, except where otherwise shown or required for proper installation of pipe joists, fittings, valves and other work. Excavate for other mechanical work to provide minimum practical but adequate working clearances.
 4. Depth for Direct Support: For work to be supported directly on undisturbed soil, do not excavate beyond indicated depths, and hand-excavate bottom cut to accurate elevations.
 5. Depth for Subbase Support: For large piping (6" pipe size and larger), tanks, and where indicated for other mechanical work, excavate for installation of subbase material in depth indicated or, if not otherwise indicated, 6" below bottom of work to be supported.
 6. Shoring and Bracing: Provide materials for shoring and bracing to comply with local codes and authorities having jurisdiction. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as

excavation progresses.

7. Excavation for Trenches:

- 1) Dig trenches to uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 6" to 9" clearance on both sides of piping.
- 2) Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.
- 3) Where rock is encountered, carry excavation 6" below required elevation and backfill with 6" layer of crushed stone or gravel prior to installation of pipe.
- 4) For piping 5" or less in nominal size, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support piping on undisturbed soil.
- 5) For piping 6" and larger in nominal size, tanks, and other mechanical work indicated to receive subbase, excavate to subbase depth indicated, or if not otherwise indicated, to below bottom of work to be supported.
- 6) Grade bottoms of trenches as indicated, notching under piping couplings to provide solid bearing for entire body of piping.
- 7) Depth for Exterior Piping: Except as otherwise indicated, excavate for exterior piping so that depth of cover shall be 18" minimum.
- 8) Excavate near large trees (within drip line) by hand, and protect root system from damage or dryout to greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with asphaltic tree paint.
- 9) Store excavated material (temporarily) near excavation, in manner that will not interfere with or damage excavation or other work. Do not store under trees (within drip line). Retain excavated material that complies with requirements for backfill material. Dispose of excavated material that is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material.

B. Backfill

1. Do not backfill until installed mechanical work has been tested and accepted, wherever testing is indicated.
2. Backfill with finely-graded subbase material to 6" above wrapped, coated, and plastic piping and tanks, and to centerline of other tanks.
3. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to required densities. Do not backfill with frozen soil materials.
4. Backfill simultaneously on opposite sides of mechanical work, and compact simultaneously; do not dislocate work from installed positions.
5. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (% of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment.
6. Lawn and Landscaped Areas: 85% for cohesive soils; 90% for cohesionless soils.
7. Paved Areas Other Than Roadways: 90% for cohesive soils; 95% for cohesionless soils.
8. Roadways: 90% for cohesive soils; 95% for cohesionless soils.
9. Backfill to elevations matching adjacent grades, at a time of backfilling excavations for mechanical work.

C. Performance and Maintenance

1. Subsidence: Where subsidence is measurable or observable at mechanical work excavations during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION

**SECTION 23 0513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

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.
- B. Refer to Common Motor Requirements for Equipment, Section 220513, for HVAC motors.

PART 2 PRODUCTS (NOT USED.)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

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**SECTION 23 0516
EXPANSION FITTINGS AND LOOPS 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. Flexible, ball-joint, packed expansion joints.
 - 2. Slip-joint packed expansion joints.
 - 3. Expansion-compensator packless expansion joints.
 - 4. Flexible-hose packless expansion joints.
 - 5. Metal-bellows packless expansion joints.
 - 6. Rubber packless expansion joints.
 - 7. Grooved-joint expansion joints.
 - 8. Pipe loops and swing connections.
 - 9. Alignment guides and anchors.

1.03 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide 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. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.01 PACKED EXPANSION JOINTS

- A. Flexible, Ball-Joint, Packed Expansion Joints:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Thermal Systems, Inc.
 - b. Hyspan Precision Products, Inc.
 - 2. Standards: ASME Boiler and Pressure Vessel Code: Section II, "Materials"; and ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
 - 3. Material: Carbon-steel assembly with asbestos-free composition packing.

4. Design: For 360-degree rotation and angular deflection.
 5. Minimum Pressure Rating: 250 psig (1723.69 kPa) at 400 deg F (250 psi (1725 kPa) at 204 deg C).
 6. Angular Deflection for NPS 6 (DN 150) and Smaller: 30 degree minimum.
 7. Angular Deflection for NPS 8 (DN 200) and Larger: 15 degree minimum.
 8. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
 9. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.
- B. Slip-Joint Packed Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Thermal Systems, Inc.
 - b. Hyspan Precision Products, Inc.
 2. Standard: ASTM F 1007.
 3. Material: Carbon steel with asbestos-free PTFE packing.
 4. Design: With internal guide and injection device for repacking under pressure. Include drip connection if used for steam piping.
 5. Configuration: Single joint and/or double joint as indicated on the drawings.
 6. End Connections: Flanged or weld ends to match piping system.

2.02 PACKLESS EXPANSION JOINTS

- A. Metal, Expansion-Compensator Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Flexicraft Industries.
 - b. Hyspan Precision Products, Inc.
 - c. Metraflex, Inc.
 2. Minimum Pressure Rating: 150 psig (1034.21 kPa) unless otherwise indicated.
 3. Configuration for Copper Tubing: Two-ply, phosphor-bronze bellows with copper pipe ends.
 - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded.
 4. Configuration for Steel Piping: Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.
- B. Rubber, Expansion-Compensator Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
 - b. Flexicraft Industries.
 - c. Mason Industries, Inc.; Mercer Rubber Co.
 2. Material: Twin reinforced-rubber spheres with external restraining cables.
 3. Minimum Pressure Rating: 150 psig (1034.21 kPa) at 170 deg F (150 psi (1035 kPa) at 77 deg C) unless otherwise indicated.
 4. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
- C. Flexible-Hose Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Flexicraft Industries.
 - b. Metraflex, Inc.
 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
 4. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig (3102.64 kPa) at 70 deg F (450 psi (3100 kPa) at 21 deg C) and 340 psig (2344.22 kPa) at 450 deg F (339 psi (2340 kPa) at 232 deg C) ratings.
 - b. Bronze hoses and double-braid bronze sheaths with 700 psig (4826.33 kPa) at 70 deg F (701 psi (4830 kPa) at 21 deg C) and 500 psig (3447.38 kPa) at 450 deg F (500 psi (3450 kPa) at 232 deg C) ratings.
 5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig (2068.43 kPa) at 70 deg F (300 psi (2070 kPa) at 21 deg C) and 225 psig (1551.32 kPa) at 450 deg F (225 psi (1550 kPa) at 232 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig (2895.80 kPa) at 70 deg F (419 psi (2890 kPa) at 21 deg C) and 315 psig (2171.85 kPa) at 450 deg F (315 psi (2170 kPa) at 232 deg C) ratings.
 6. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig (3102.64 kPa) at 70 deg F (450 psi (3100 kPa) at 21 deg C) and 325 psig (2240.80 kPa) at 600 deg F (326 psi (2250 kPa) at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig (4826.33 kPa) at 70 deg F (701 psi (4830 kPa) at 21 deg C) and 515 psig (3550.80 kPa) at 600 deg F (515 psi (3550 kPa) at 315 deg C) ratings.
 7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig (1378.95 kPa) at 70 deg F (200 psi (1380 kPa) at 21 deg C) and 145 psig (999.74 kPa) at 600 deg F (145 psi (1000 kPa) at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig (1896.06 kPa) at 70 deg F (276 psi (1900 kPa) at 21 deg C) and 200 psig (1378.95 kPa) at 600 deg F (200 psi (1380 kPa) at 315 deg C) ratings.
 8. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Carbon-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig (861.84 kPa) at 70 deg F (125 psi (860 kPa) at 21 deg C) and 90 psig (620.53 kPa) at 600 deg F (91 psi (625 kPa) at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig (1137.64 kPa) at 70 deg F (164 psi (1130 kPa) at 21 deg C) and 120 psig (827.37 kPa) at 600 deg F (120 psi (830 kPa) at 315 deg C) ratings.
 9. Expansion Joints for Steel Piping NPS 14 (DN 350) and Larger: Carbon-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig (1137.64 kPa) at 70 deg F (164 psi (1130 kPa) at 21 deg C) and 120 psig (827.37 kPa) at 600 deg F (120 psi (830 kPa) at 315 deg C) ratings.
- D. Metal-Bellows Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the

- following:
- a. Flexicraft Industries.
 - b. Flo Fab inc.
 - c. Hyspan Precision Products, Inc.
 - d. Metraflex, Inc.
 - e. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.
2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 3. Type: Circular, corrugated bellows with external tie rods.
 4. Minimum Pressure Rating: 150 psig (1034.21 kPa) unless otherwise indicated.
 5. Configuration: Single joint and/or double joint as indicated on the drawings.
 6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): threaded.
 - c. End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.
 7. Expansion Joints for Steel Piping: Single- or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged.
- E. Rubber Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
 - b. Flexicraft Industries.
 - c. Mason Industries, Inc.; Mercer Rubber Co.
 - d. Metraflex, Inc.
 2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
 3. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
 4. Arch Type: Multiple arches.
 5. Spherical Type: Multiple spheres.
 6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1034.21 kPa) at 220 deg F (104 deg C).
 7. Minimum Pressure Rating for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (965.27 kPa) at 200 deg F (93 deg C).
 8. Minimum Pressure Rating for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (965.27 kPa) at 180 deg F (82 deg C).
 9. Material for Water: EPDM.
 10. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.03 GROOVED-JOINT EXPANSION JOINTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Anvil International, Inc.
 2. Victaulic Company.
- B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- C. Standard: AWWA C606, for grooved joints.
- D. Nipples: ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

- E. Couplings: Flexible type for steel-pipe dimensions. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.

2.04 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
 - 1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.
- B. Anchor Materials:
 - 1. Steel Shapes and Plates: ASTM A 36/A 36M.
 - 2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
 - 3. Washers: ASTM F 844, steel, plain, flat washers.
 - 4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
 - 5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 EXECUTION

3.01 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install packed-type expansion joints with packing suitable for fluid service.
- C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- D. Install rubber packless expansion joints according to FSA-NMEJ-702.
- E. Install grooved-joint expansion joints to grooved-end steel piping

3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.

- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

**SECTION 23 0519
METERS AND GAGES 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. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Test plugs.
 - 5. Sight flow indicators.
- B. Related Sections:
 - 1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.
 - 2. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Standard: ASME B40.200.
 - 2. Case: Cast aluminum; 7-inch (178-mm) nominal size unless otherwise indicated.
 - 3. Case Form: Adjustable angle unless otherwise indicated.
 - 4. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
 - 6. Window: Plastic.
 - 7. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
 - 8. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
 - 9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.02 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.03 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR.
 - 4. Material for Use with Steel Piping: CSA.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25.) ASME B1.20.1 pipe threads.
 - 7. Internal Threads: 1/2, 3/4, and 1 inch (25.4 mm), with ASME B1.1 screw threads.

8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.04 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Standard: ASME B40.100.
 2. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
 3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 4. Pressure Connection: Brass, with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
 7. Pointer: Dark-colored metal.
 8. Window: Plastic.
 9. Ring: Metal.
 10. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.05 TEST PLUGS

- A. Description: Test-station fitting made for insertion into piping tee fitting.
- B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- C. Thread Size: NPS 1/4 (DN 8), ASME B1.20.1 pipe thread.
- D. Minimum Pressure and Temperature Rating: 500 psig (3447.38 kPa) at 200 deg F (500 psi (3450 kPa) at 93 deg C).
- E. Core Inserts: EPDM self-sealing rubber.

2.06 SIGHT FLOW INDICATORS

- A. Description: Piping inline-installation device for visual verification of flow.
- B. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- C. Minimum Pressure Rating: 150 psig (1034.21 kPa).
- D. Minimum Temperature Rating: 200 deg F (93 deg C).
- E. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
- F. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install test plugs in piping tees.
- I. Install flow indicators in piping systems in accessible positions for easy viewing.
- J. Install permanent indicators on walls or brackets in accessible and readable positions.
- K. Install connection fittings in accessible locations for attachment to portable indicators.
- L. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler.
 - 3. Two inlets and two outlets of each chiller.
 - 4. Inlet and outlet of each hydronic coil in air-handling units.
 - 5. Two inlets and two outlets of each hydronic heat exchanger.
 - 6. Inlet and outlet of each thermal-storage tank.
 - 7. Outside-, return-, supply-, and mixed-air ducts at AHUs.
 - 8. Outlet of each domestic water heater or storage tank.
- M. Install pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - 3. Suction and discharge of each pump.
 - 4. Inlet and outlet of each hydronic coil in air handling units.

3.02 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).
- B. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C).
- C. Scale Range for Air Ducts: Minus 40 to plus 110 deg F (Minus 40 to plus 45 deg C).
- D. Scale Range for Domestic Hot Water: 30 to 180 deg. F with 2-degree divisions (minus 1 to plus 82 deg. C, with 1-degree divisions).

3.05 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 psi (689.48 kPa).
- B. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi (689.48 kPa).

END OF SECTION

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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.
- B. Refer to General Duty Valves for piping systems, Section 220523, for HVAC valves.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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**SECTION 23 0529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Refer to Hangers and Supports for Piping and Equipment, Section 220529, for HVAC supports.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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**SECTION 23 0548
VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT**

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. This Section includes the following:
 - 1. Isolation pads.
 - 2. Freestanding and restrained spring isolators.
 - 3. Elastomeric hangers.
 - 4. Spring hangers.
 - 5. Restrained vibration isolation roof-curb rails.
 - 6. Steel and inertia, vibration isolation equipment bases.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
- B. Delegated-Design Submittal: For vibration isolation 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation to select vibration isolators, and for designing vibration isolation bases.
 - 2. 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.
 - 3. 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.
 - 4. Select the required minimum isolator deflection to satisfy the requirements of each piece of equipment at each unique installation.

1.05 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. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed in the specification.
 - 1. Amber/Booth Company, Inc.

2. Kinetics Noise Control.
 3. Mason Industries.
 4. Vibration Eliminator Co., Inc.
- B. Pads (Type 1): Arranged in two 3/8" layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.
 2. Peabody Type NGDD, Mason Type WSW or approved equal.
- C. Elastomeric Hangers (Type 2a): A rubber suspension type isolator with an elastomeric hanger, consisting of a rectangular steel box and elastomeric isolation element, which shall be of Neoprene or high quality synthetic rubber with ozone and anti-oxidant additives. The elements shall be designed for approximately 1/4-inch deflection and loaded so that deflection does not exceed 15% of the free height of the element. The design shall prevent metal-to-metal contact between the hanger rod and the steel box. Shall be Peabody Type RH, Mason Type HD, or approved equal.
- D. Spring Isolators (Type 3): Provide a base mount type isolator with adjustable, free standing open-spring mounting with combination leveling bolt and equipment fastening bolt. The spring (or springs) shall be rigidly attached to the mounting baseplate and to the spring compression plate. To assure stability, the outside diameter shall be a minimum of 0.8 times the vertical operating height. The isolator shall be designed for a minimum K_x/K_y (horizontal to vertical spring rate) of 1.0. A Neoprene pad having a minimum thickness of 1/4-inch shall be bonded to the bottom of the baseplate. Baseplates shall be sized to limit pad loading to 100psi. Shall be Peabody type FDS, Mason Type SLF, or approved equal.
- E. Spring Hangers (Type 3a): A suspension type isolator with spring hanger consisting of a rectangular steel box, coil springs, spring cups, Neoprene impregnated fabric washer, steel washer and Neoprene insert designed to prevent metal-to-metal contact between the rod and the bottom of the hanger box. The hanger box shall be capable of supporting 40% of rated load without noticeable deformation or failure. Shall be Peabody Type SH, Mason Type HS, or approved equal.
- F. Spring Hangers (Type 3b): A suspension type isolator with spring hanger as described in Type 3a, with the addition of an elastomeric element at the top of the box for acoustic isolation. The design shall prevent metal-to-metal contact between the hanger rod and the top of the hanger box. The elastomeric element shall meet the design requirements for Type 2 mounting. Shall be Peabody Type SRH, Mason Type DNHS, or approved equal.
- G. Restrained Spring Isolators (Type 4): A base mount type isolator with an adjustable, open-spring isolator having one or more coil springs rigidly attached to a top compression plate and a baseplate. A ribbed or waffled neoprene pad having a minimum thickness of 1/4-inch shall be bonded to the bottom of the baseplate. The isolator shall fit within a welded steel enclosure consisting of a top plate and a rigid lower housing, serving as a blocking device during installation. Restraining bolts shall connect the top-plate and lower housing to prevent the isolated equipment from rising when drained of water. Neoprene grommets shall be provided to prevent metal-to-metal contact between the restraining bolts and isolator housing. Baseplates shall be sized to limit pad loading to 100 psi (689.48 kPa), and springs shall be designed for a minimum K_x/K_y (horizontal to vertical spring rate) of 1.0. Shall be Peabody type FLS, Mason Type SLR, or approved equal.
- H. Riser Isolators: Provide manufacturer's standard pad-type isolator bonded to steel plate, formed for welding to pipe sleeve extension.
- I. Riser Support Isolators: Provide manufacturer's standard pad-type isolator laminated between two formed steel plate members, one for welding to pipe sleeve extension and the other for welding to pipe riser.

2.02 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS (TYPE D)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Mason Industries.
 - 3. Vibration Eliminator Co., Inc.
 - 4. Kinetics Noise Control.
- B. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.
- C. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment. 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 (50.8 mm) of rigid, glass-fiber insulation on inside of assembly.
- D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- (6-mm-) 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.
 - 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.
 - 2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - a. Resilient Material: Oil- and water-resistant standard neoprene.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6.35 mm) thick.
- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.03 VIBRATION ISOLATION EQUIPMENT BASES

- A. No Base (Type A): Isolators directly attached to equipment.
- B. Structural Steel Rails or Base (Type B): Where rails or beams are indicated for use with isolator units to support equipment, provide structural steel support members with isolator support brackets and anchor bolt holes, designed by the vibration isolation materials manufacturer. Structural steel bases shall comply with ANSI/ASTM A36, and shall have a minimum depth equal to 10% of the longest span between isolators, but not less than (4) inches, or as indicated in the Drawings. Sizes and shapes shall be as requires for equipment to be supported. Isolator support brackets shall be welded to the structural beam base as required to provide the lowest possible mounting height of supported equipment. Steel beams shall provide a rigid, distortion -free mounting base for supported equipment without excessive differential motion between driving and driven equipment components.
- C. Inertia Base (Type C): Provide reinforced concrete inertia blocks, including perimeter steel pouring form, reinforcing bars welded in place, bolting templates, and height saving brackets for

mounting of the isolators. Each inertia block shall have a thickness of at least six (6) inches, or greater, as required to provide a rigid mounting for equipment. The weight of each inertia block shall not be less than 150% of the weight of equipment supported. Inertia blocks shall be sized to extend not less than four (4) inches beyond the base of the supported equipment in each direction and shall be T-shaped where necessary to conserve space. Inertia blocks for pumps shall support the suction elbows on end suction pumps, and both the suction and discharge elbows on horizontal split case pumps. Perimeter steel members shall be structural channels having a minimum depth of 10% of the longest span, but not less than six (6) inches. Shall be Peabody Type C1B-H, Mason Type KSL or BMK, or approved equal.

2.04 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 control devices to indicate capacity range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- 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.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. This work in general shall include, but not necessarily be limited to, the following:
 - 1. Isolate all mechanical and electrical equipment from the building structure by means of appropriately selected noise and vibration isolator.
 - 2. Piping over 1-inch o.d. located in mechanical equipment rooms, for minimum of 50 feet (1524 cm) or 100 pipe diameters (whichever is greater) from the connection to the vibration isolated equipment, shall be isolated from the building structure by means of noise and vibration isolation hangers. Provide the first three (3) hangers or support points in each direction from each piece of isolated equipment, with vibration isolation hangers or supports having the same static deflection as the equipment isolators.
 - 3. Ductwork which is rigidly attached to isolated air moving equipment in mechanical equipment rooms shall be isolated from the building structure by means of noise and vibration isolation hangers or mounts for a minimum of 50 feet (1524 cm).
 - 4. Isolate piping and duct vertical risers from the building structure by means of noise and vibration isolation guides and supports.
- C. Piping and ductwork isolated in accordance with these Specifications shall freely pass through walls and floors without rigid connections. After installation of piping and ductwork, caulk penetrations airtight.
- D. General: Comply with the minimum static deflections recommended by the ASHRAE, including definitions of critical and non-critical locations, for selection and application of vibration isolation materials and units as indicated.
- E. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.

3.03 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. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
- C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- D. 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.
- E. 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.
- F. 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.

3.04 ADJUSTING

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

3.05 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

- A. Below is a schedule of isolated equipment for this project. Any equipment, system, construction or condition that may be altered, added or changed, or that is not specifically considered herein or on the drawings, shall be treated in the same manner as specified for similar equipment, systems, or construction shall comply with the noise and vibration isolation requirements of these specifications.

EQUIPMENT TYPE	BASE TYPE	ISOLATOR TYPE	ISOLATOR DEFLECTION
FANS			
Cabinet, floor-mounted	A	3	
Cabinet, suspended	-	3bb	

Centrifugal, DWDI, floor-mounted	C	3	
Axial flow, floor-mounted	C	3	
Centrifugal, in-line floor-mounted	C	3	
Centrifugal, in-line, suspended	-	3bb	
Utility vent sets	A or B	3	
Roof exhausters, curb-mounted	Aa	1	
Cooling Towers, roof mounted	B	3 or 4c	
PIPING	A	2a, 3a or 3b	
DUCTS	A	2a, 3a or 3b	
AIR HANDLING UNITS			
Factory-fabricated, floor-mounted	A	3e	
Factory-fabricated, suspended	-	3bb	
Factory-fabricated, roof-mounted	Dd	3	
Factory-fabricated, roof-mounted	A or B	3	
CHILLERS			
Grade Supported	A	1 or 4	
PUMPS			
Floor Mounted	C	3	
Suspended	-	3bb	
Packaged Systems	A	4	
AIR COMPRESSORS			
Reciprocating	C	4	
Rotary or centrifugal	C	4	

-
- A. MOUNT ISOLATION BETWEEN CURB AND FAN.**
 - B. MOUNT UNITS ON STEEL CHANNEL FRAME AND SUSPEND FRAME FROM STRUCTURE.**
 - C. COOLING TOWER SUPPORTS SHALL BE SELECTED AND EMPLOYED IN A MANNER THAT RESULTS IN SUPPORTING THE COOLING TOWER IN CONFORMANCE WITH THE RECOMMENDATIONS OF THE TOWER MANUFACTURER.**
 - D. CUSTOM FABRICATED CURB FIT TO THE DIMENSIONS AND WEIGHTS OF THE RTU.**
 - E. DELETE ISOLATORS BENEATH UNIT IF INTERNALLY ISOLATED. IN LIEU OF SPRING ISOLATORS, PROVIDE ISOLATION TYPE 1.**

9.01 TESTING AND CERTIFICATION

- A. Upon completion of the installation and after the system is put into operation, inspect the systems of vibration control and correct any discrepancies or make adjustments. If necessary, instrumentation tests and measurements shall be made to determine the source, cause, and path of any objectionable vibration. After such tests are completed, take proper steps to correct the objectionable condition.
- B. The noise and vibration control equipment manufacturer or his designated representative shall certify the correctness of the installation and compliance with requirements of this Section.

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**SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

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.
- B. Refer to Identification for Piping and Equipment, Section 220553, for HVAC identification.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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**SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC**

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. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.
- B. Related Sections
 - 1. Division 23 Section "Metal Ducts" for duct sealing and testing.

1.03 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.04 SUBMITTALS

- A. LEED Submittal:
 - 1. Air-Balance Report for LEED Prerequisite IEQ-Minimum Indoor Air Quality Performance: Documentation of work performed for ASHRAE 62.1, Section 7.2.2, "Air Balancing."
- B. Certified TAB reports.

1.05 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage an impartial TAB entity certified by AABC.
 - 1. The firm will be one that is organized to provide independent professional testing, adjusting and balancing services. The firm shall have one (1) Professional Engineer licensed in the state where the project is located, with current registration.
 - 2. The firm will have operated a minimum of five (5) years under its current firm name.
 - 3. All personnel used on the jobsite shall be either TAB engineers or TAB technicians who shall have been permanent, full-time employees of the firm for a minimum of six (6) months prior to working on this specific project.
 - 4. TAB firm shall submit the following to the Architect/Engineer and/or owner for approval prior to commencing services:
 - a. Name and biographical data of the Professional Engineer and all personnel to be assigned to this project.
 - b. Proof of company operation for a minimum of five (5) years.
- B. TAB Conference: Meet with Architect-Engineer and Commissioning Authority for approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.

- c. Coordination and cooperation of trades and subcontractors.
- d. Coordination of documentation and communication flow.

1.06 COORDINATION

- A. Notice: Provide seven (7) days advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests after air and water distribution systems have been satisfactorily completed.
- C. The contractor shall make any changes in the sheaves, belts, motors, dampers and valves or the addition of dampers and/or valves as required, to correctly balance the HVAC systems, at no additional cost.
- D. The automatic temperature control contractor and/or energy management system contractor shall thoroughly check all controls, sensors, operators, sequences, etc. before notifying the TAB agency that the automatic temperature controls and energy management system are operational. The automatic temperature control contractor and/or energy management system contractor shall provide technical support (technicians and necessary computers) to the TAB agency for a complete check of these systems. The scope of the TAB work as defined herein is indicated in order that the contractor will be apprised of his responsibility regarding the coordination and assistance required to complete the project requirements for final TAB. The TAB firm will be responsible to the architect/engineer and/or owner for the satisfactory execution of the TAB services.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves.
 - 1. 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.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare 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 indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts or install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- 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 airflow patterns from the outdoor-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.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."
- M. During the balancing process, all abnormalities or malfunctions of equipment or components discovered by the TAB personnel will be reported promptly to the architect/engineer, owner and contractor so that the condition can be corrected expediently.
- N. The temperature controls will be verified for calibration and proper relationship between control devices. The contractor will be advised of any instruments out of calibration so that the automatic temperature controls (ATC) contractor can recalibrate, using data supplied by the TAB firm. The ATC contractor shall assist the TAB firm as required.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical 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 the 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.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain 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. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 - 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and

the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record final fan-performance data.

3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check liquid level in expansion tank.
 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.

6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.08 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Commissioning Authority and comply with requirements in Division 23 Section "Hydronic Pumps."
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 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 of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.11 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.12 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
 - 1. Measure condenser-water flow to each cell of the cooling tower.
 - 2. Measure entering- and leaving-water temperatures.
 - 3. Measure wet- and dry-bulb temperatures of entering air.
 - 4. Measure wet- and dry-bulb temperatures of leaving air.
 - 5. Measure condenser-water flow rate recirculating through the cooling tower.
 - 6. Measure cooling-tower spray pump discharge pressure.
 - 7. Adjust water level and feed rate of makeup water system.
 - 8. Measure flow through bypass.

3.13 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.14 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

- B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.15 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each coil:
 1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
 7. Air pressure drop.

3.16 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate-drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.

3.17 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 or minus 5 percent.
 2. Air Outlets and Inlets: Plus 10 or minus 5 percent.
 3. Heating-Water Flow Rate: Plus 10 or minus 5 percent.
 4. Cooling-Water Flow Rate: Plus 10 or minus 5 percent.

3.18 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to 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; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.

- i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- E. Apparatus-Coil Test Reports:
 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch (mm) o.c.
 - f. Make and model number.
 - g. Face area in sq. ft. (sq. m).
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Water flow rate in gpm (L/s).
 - i. Water pressure differential in feet of head or psig (kPa).
 - j. Entering-water temperature in deg F (deg C).
 - k. Leaving-water temperature in deg F (deg C).
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig (kPa).
 - n. Refrigerant suction temperature in deg F (deg C).
 - o. Inlet steam pressure in psig (kPa).

- F. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches (mm), and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Entering-air temperature in deg F (deg C).
 - c. Leaving-air temperature in deg F (deg C).
 - d. Air temperature differential in deg F (deg C).
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).
 - i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F (deg C).
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm (L/s).
 - i. Face area in sq. ft. (sq. m).
 - j. Minimum face velocity in fpm (m/s).
 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Air flow rate in cfm (L/s).
 - c. Air velocity in fpm (m/s).
 - d. Entering-air temperature in deg F (deg C).
 - e. Leaving-air temperature in deg F (deg C).

- f. Voltage at each connection.
- g. Amperage for each phase.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches (mm), and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated air flow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual air flow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).
- J. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft. (sq. m).
 - 2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary air flow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final air flow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in deg F (deg C).
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Entering-water temperature in deg F (deg C).
 - c. Leaving-water temperature in deg F (deg C).
 - d. Water pressure drop in feet of head or psig (kPa).
 - e. Entering-air temperature in deg F (deg C).
 - f. Leaving-air temperature in deg F (deg C).
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm (L/s).
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches (mm).
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches (mm).
 - d. Full-open flow rate in gpm (L/s).
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).
 - h. Final total pressure in feet of head or psig (kPa).
 - i. Final water flow rate in gpm (L/s).
 - j. Voltage at each connection.
 - k. Amperage for each phase.

- M. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.19 INSPECTIONS

- A. Initial Inspection:
 - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
 - 2. Check the following for each system:
 - a. Measure airflow of at least 5 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
 - 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
 - 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
 - 3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to 5 percent of the total measurements recorded.
 - 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 - 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
 - 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.20 ADDITIONAL TESTS

- A. Thoroughly test the Energy Management System (EMS). The testing of the Energy Management System shall include all HVAC controls, sensors, operators, sequences, etc. The tests shall include verification that commands introduced at the EMS console actually occur and temperatures, pressures, etc. indicated at the EMS console correlate with the actual reading at the sensing point. The ATC contractor and/or EMS contractor shall provide technical support to the TAB Firm for a complete check of the HVAC temperature controls and/or the Energy Management System.

- B. After testing, adjusting and balancing to design conditions, if comfort conditions are not being maintained, the air conditioning system shall be rebalanced within the limitations of the equipment installed to obtain comfort conditions. If comfort conditions cannot be obtained, a report will be submitted giving specific data regarding the trouble area.
- C. Make a total of three (3) inspections within ninety (90) days after occupancy of the building, and make adjustments if required, to insure that satisfactory conditions are being maintained throughout. Inspections to be coordinated with Architect/Engineer and Owner and shall be documented with a supplemental report containing data and information as required.
- D. Make an inspection during the opposite season from that in which the initial adjustments were made and at that time make any necessary modifications to the initial adjustment required to produce optimum operation of the systemic components to produce the proper conditions in each conditioned space. The opposite season inspection shall be coordinated with the Architect/Engineer and Owner. This inspection shall be documented with a supplemental report containing any pertinent data and information regarding readings and adjustments made.

END OF SECTION

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**SECTION 23 0700
HVAC INSULATION**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).

1.02 RELATED DOCUMENTS

- A. Refer to Insulation Schedule Shown on Plans

1.03 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials
 - 2. Fire-rated insulation systems.
 - 3. Factory-applied jackets.
 - 4. Field-applied jackets.
 - 5. Securements.
- B. Related Sections:
 - 1. Section 220700 - Plumbing Insulation.
 - 2. Section 233113 - Metal Ducts for duct liners.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. LEED Compliant Adhesives and Sealants:
 - 1. Product Data for Credit IEQ-Low-Emitting Materials: For adhesives and sealants, including printed statement of VOC content.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting 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.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. All insulation shall be kept dry and clean during storage and installation. Insulation that becomes wet shall be discarded.

1.07 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. 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.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Thermo-12 Gold.
 - b. Or, approved equal.
 - 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.
- G. Elastomeric Closed Cell Foam: Comply with ASTM C 534, (0.28 Btu in/hr ft² at 75 degrees Fahrenheit (23.89 degrees Celsius)), and containing anti-microbial product protection. Temperature range of -220 degrees Fahrenheit (104.44 degrees Celsius) to +220 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; AP Armaflex.
 - b. Or, approved equal.
- H. Glass Fiber Duct Wrap: Rigid, resin bonded fibrous glass blanket with a damage resistant, flame retardant, reinforced aluminum foil facing (FRK). Comply with ASTM C1136, Type II and ASTM C1290 Type III requirements. Type 75 (0.75 lb/cu.ft density). Thermal Conductivity shall be 0.30 Btu*in/h*ft² at 75 degrees Fahrenheit (23.89 degrees Celsius).) R value for 1.5" = 4.2, 2.0"=5.6, 2.2"=6.0 installed.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following:
 - a. CertainTeed Corp.;
 - b. Johns Manville.;
 - c. Knauf Insulation.;
 - d. Owens Corning.;
- I. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB (0.24 Btu in/h ft² at 75 degrees Fahrenheit (23.89 degrees Celsius)). For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.;
 - c. Knauf Insulation.;
 - d. Owens Corning.;

- J. Glass Fiber Pipe and Tank Insulation: Molded fibrous glass pipe insulation with factory-applied ASJ complying with ASTM C1393 and ASTM E96. Nominal density is 3.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.24 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Operating range of 0 degrees Fahrenheit (-17.78 degrees Celsius) to 1,000 deg F.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
- K. VaporWick Pipe Insulation: Molded fibrous glass pipe insulation with self-drying type with vapor retarder with factory-applied integral vapor retarder. Provide factory jacket complying with ASTM C1393 and ASTM D774. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.24 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Operating range of 32 degrees Fahrenheit (0 degrees Celsius) to 220 degrees Fahrenheit (104.44 degrees Celsius).
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.

2.02 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Thermal Ceramics; FireMaster Duct Wrap.
 - d. FyreWrap.

2.03 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136.

2.04 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 PVC Corporation; LoSmoke.
 2. Color: White
 3. 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.
- 4. Factory-fabricated tank heads and tank side panels.
- 5. 25 Flame Spread, 50 Smoke Developed.
- C. Metal Jacket:
 - 1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. 0.016" up through 24" pipe size, 0.024" for pipe sizes larger than 24" and all ductwork.
 - 2. Stainless Steel Jacket: Type T-304.
 - a. 0.010" smooth finish
 - b. 0.010" corrugated finish for diameters larger than 6 feet (182.88 cm).
- D. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Polyguard; Alumaguard 60.

2.05 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (12.7 mm) wide.
 - 2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
 - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.
 - 2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 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. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0 inch (0.13 mm)) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range

- between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
 - D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (101.6 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 2 inches (50.8 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and 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 (101.6 mm) 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 (50.8 mm) 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 (50.8 mm).
 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. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50.8 mm).
 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
 2. Provide UL-approved assemblies.
- F. Insulation Installation at Floor Penetrations:
 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves

and externally insulate damper sleeve beyond floor to match adjacent duct insulation.
Overlap damper sleeve and duct insulation at least 2 inches (50.8 mm).

2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.05 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (76.2 mm) from insulation end joints, and 16 inches (406.4 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (152.4 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (304.8 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1219.2 mm) o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches (76.2 mm).
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.040 inch (1.02 mm) thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.06 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 and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. 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, vessels, and equipment. 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 (50.8 mm) 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.

3.07 CALCIUM SILICATE INSULATION INSTALLATION

- A. Insulation Installation on Boiler Breechings and Ducts:
1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation material.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (76.2 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
 3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch (25.4 mm). Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.
- B. Insulation Installation on Straight Pipes and Tubes:
1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (76.2 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) 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 (25.4 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- C. 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.
- D. 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.
- E. 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.

3.08 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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.
- E. Insulation Installation on Ductwork:
1. Install sheet insulation as duct liner where indicated on the drawings or elsewhere in the specifications.
 2. Adhesive should have 100% coverage applied to both surfaces.
 3. Install according to ASTM C1710 and manufacturer's recommendations.

3.09 GLASS-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (152.4 mm) o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 (25.4 mm), 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.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (457.2 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (76.2 mm) maximum from insulation end joints, and 16 inches (406.4 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (457.2 mm), place pins 16 inches (406.4 mm) o.c. each way, and 3 inches (76.2 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50.8 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25.4 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 degrees Fahrenheit (10 degrees Celsius) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of

- insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (76.2 mm).
5. Overlap unfaced blankets a minimum of 2 inches (50.8 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (457.2 mm) o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (152.4 mm) o.c.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (457.2 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (76.2 mm) maximum from insulation end joints, and 16 inches (406.4 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (457.2 mm), space pins 16 inches (406.4 mm) o.c. each way, and 3 inches (76.2 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50.8 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25.4 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 degrees Fahrenheit (10 degrees Celsius) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (76.2 mm).
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (152.4 mm) o.c.

3.10 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are required, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (304.8 mm) o.c. and at end joints.

3.11 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.12 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum or stainless-steel jackets.

3.13 DUCT INSULATION SCHEDULE, GENERAL

- A. Refer to the drawing schedule for insulation types & requirements.
- B. Items Not Insulated:
 - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 2. Factory-insulated flexible ducts.
 - 3. Factory-insulated plenums and casings.
 - 4. Flexible duct connectors.
 - 5. Vibration-control devices.
 - 6. Factory-insulated access panels and doors.

3.14 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. All underground piping requiring insulation shall be factory insulated. Field insulated underground piping is NOT allowed.

3.15 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, Exposed in all mechanical rooms:
 - 1. PVC: 20 mils (0.02 inch (0.5 mm)) thick.
- D. Piping, Exposed, Outdoors:
 - 1. Aluminum Corrugated 0.016" thick up through 24" pipe size and 0.024 inch (0.61 mm) thick larger than 24" pipe size.
- E. Generator Exhaust Piping:
 - 1. Smooth aluminum, 0.016" thick up through 12" pipe size, 0.024" thick for larger than 12"

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**SECTION 23 0900
INSTRUMENTATION AND CONTROL FOR HVAC**

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. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
 - 1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
 - 2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.
- C. Scope: This is a new Dining Hall in the middle of UNT's Denton campus. The building should be connected to the campus BMS. Refer to this specification, UNT Design Guidelines, and the mechanical controls contract drawings.

1.03 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. BACnet, Modbus: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PID: Proportional plus integral plus derivative.
- F. RTD: Resistance temperature detector.

1.04 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with current state of the art dynamic points and refresh speed.
 - 2. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 - 3. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 - 4. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
 - 5. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
 - 6. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
 - 7. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
 - e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
 - f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
 - g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).

- h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
- i. Relative Humidity: Plus or minus 5 percent.
- j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
- k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
- l. Airflow (Terminal): Plus or minus 10 percent of full scale.
- m. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
- n. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
- o. Carbon Monoxide: Plus or minus 5 percent of reading.
- p. Carbon Dioxide: Plus or minus 50 ppm.
- q. Electrical: Plus or minus 5 percent of reading.

1.05 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Floor plans indicating control panel locations.
 - 6. Written description of sequence of operation.
 - 7. Schedule of dampers including size, leakage, and flow characteristics.
 - 8. Schedule of valves including flow characteristics.
 - 9. Panel and circuit number of any additional 120V power required.
 - 10. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 - 11. Control System Software: Graphics outline and "Print Page" examples of final product indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 - 12. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.

- C. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 5. Calibration records and list of set points.
 6. Software and Firmware Operational Documentation: Include the following:
 - a. Software operating and upgrade manuals.
 - b. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - c. Device address list.
 - d. Printout of software application and graphic screens.
 - e. Software license required by and installed for DDC workstations and control systems.
 7. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.08 COORDINATION

- A. Coordinate location of temperature sensors, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 28 Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.
- C. Coordinate equipment with Division 28 Section "Access Control" to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate equipment with Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.
- E. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
- F. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.
- G. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- H. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

- I. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- J. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.
- K. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.09 WORK BY OTHERS

- A. Automatic control valves shall be furnished by the EMS contractor and installed by the Mechanical Contractor. All reducers and fittings necessary to install smaller than pipe size valves shall be furnished and installed by the Mechanical Contractor.
- B. Automatic dampers and actuators shall be furnished by the EMS contractor and installed by the Mechanical Contractor.
- C. Piping: Water pressure and differential sensors, valve manifolds, flow switches, thermal sensors shall be furnished and installed by the EMS contractor. All piping taps and wells shall be provided by the mechanical contractor in locations shown on plans and/or locations directed by the EMS contractor for optimal performance.
- D. Duct air flow monitors shall be furnished by the EMS contractor and installed by the Mechanical Contractor.
- E. Smoke Detectors: All smoke detectors, including duct mounted smoke detectors, will be provided and wired to the Fire Alarm Panel by the Fire Alarm Contractor. Duct smoke detectors will be installed by the Mechanical Contractor. Shutdown interlock wiring between starters/variable frequency drives and the Fire Alarm system shutdown contacts shall be installed by the EMS Contractor.
- F. Terminal Box DDC controllers will be furnished by the EMS Contractor to the Terminal Box Manufacturer for installation.
- G. Transformer shall be oversized to serve three (3) adjacent VAV cooling only or heating water box controllers.

PART 2 PRODUCTS

2.01 CONTROL SYSTEM

- A. Allowable EMS Vendors/Manufacturers:
 - 1. Schneider Electrical
 - 2. Automated Logic Systems
- B. All requirements from the UNT Design Guidelines shall be included in the scope of work. Those are as follows:
 - 1. The University of North Texas Denton Campus Facilities utilizes the Schneider Electric building automation control and monitoring system StruxureWare, Vista™ 5 and I/NET Seven with the associated interface hardware. Schneider Electric StruxureWare is a software suite of building management tools that control and monitor our building systems. It is based on open systems technology based on the LONWORKS® technology and NL220 protocol. New installations and construction shall be specified with Schneider Electric StruxureWare or Automated Logic equivalent.
 - 2. All end devices must be compatible with the Schneider Electric StruxureWare software front end and subsequent releases. All UNT programming or adjustments of any end device after installation shall be done through the Schneider Electric StruxureWare program and not require a secondary program.
 - 3. The programmable network devices, control panels, controllers will be provided and specified by Schneider Electric building controls or Automated Logic Systems.
 - 4. Full functionality and seamless interface to the controlled equipment through Schneider Electric StruxureWare/Automated Logic Controls is expected especially fume and

- laboratory hood controls & valves, chillers, boilers, fans, VFDs, AHUs, VAVs, lighting, metering, etc.
5. Each VAV air-handling unit will have a Dedicated Control Unit as per current UNT Spec. Only points associated with that unit will be terminated in the DCU plus IO unless for lighting, exhaust, or other not associated with another unit.
 6. Each VAV air handling unit will have 1 or more DCU controllers which will perform the data management functions for the VAV for a specific unit that the terminal units are associated to. If an air handler serves more than one floor, it will have a DCU on each floor with only that floors VAV terminals connected to it. Max of 10 terminal units per 401:B. Each VAV terminal will have a supply air sensor if the terminal unit has any heating stages.
 7. Each single zone air-handling unit will have their own controller but some of the multi zone air-handling unit may require multiple controllers. No more than 1 unit will be terminated to a base controller.
 8. Each single zone CAV, VAV or face and bypass unit will have a supply air sensor.
 9. Each air-handling unit will have a return air if the ductwork is continuous from the space back to the unit. Multi-zone units will have cold deck and hot deck sensors installed in associated decks. Return Air Temperature Sensors will be installed as a standard. Mixed air temperature sensors will not be used as a standard, unless the unit is being served by another unit (an example of this would be a dedicated outside air unit 1 serving another unit 2 – then the mixed air of 2 is really the supply air of 1).
 10. If safety device feedback is standard, the different devices (i.e.: smoke detector, freeze stat, high pressure cutout, etc.) will be a common safety circuit input to the controller. When a safety goes into alarm, only that safety's feedback will be in alarm in the controller (safeties will be wired in series to pull in a relay for status to the controller). Each AHU control panel will have a service input switch to reset any safeties and allow local personnel to disable the control of the unit. Hardwire safeties will go to the motor controller and maintenance feedback from safeties to DCU. This switch must have a label indicating that this switch is only a means of EMS shut-down/reset, not intended as a service disconnect.
 - a. Every VFD will have a LON interface and alarm in the DCU, or the following hardwired points as a minimum:
 - 1) VFD Run Indication
 - 2) VFD Speed Feedback
 - 3) VFD Speed Control
 - 4) VFD Start/Stop
 - b. Standard VFD manufacturers acceptable for UNT are ABB and Square D. Exceptions have to be approved.
 11. Each chiller, boiler plant, heating system and condenser water system will have its own dedicated DCU plus I/O controller. The Chiller and heating system controller will have a cooling or heating required LED and a plant reset pushbutton mounted on the cabinet door.
 12. Each secondary pumping system will have its own dedicated controller.
 13. A Zone Override pushbutton station will be provided at the direction of UNT, the purpose of this station will be to enable the local operator to override the scheduling of each unit or grouped zone in a building from 1 location through software. The override duration will be a timed for a default set at 2 hours.
 14. An override momentary pushbutton will be installed on the front of the panel for each major zone. See #10 for details.
 15. UNT will provide IP addresses.
 16. The university standard sequence of operations will be followed and provided by UNT. Refer to controls drawings.
 17. The university standard wiring termination will be followed.
 18. Point names in the software will include the equipment name. This must be coordinated with UNT Facilities and generally is limited to 12 characters.

19. Each controller will be labeled (controller name and equipment name) on the front of the panel door.
 20. Each controller will have a graphic printout showing wire termination by point name and wire number. The power source location will also be shown on the drawing (panel and breaker number and IP addresses). The drawing will be mounted inside the panel door in a clear plastic sleeve. There will be a separate Electronic Format file of drawings and bound reference copy.
 21. All relays, transducers and other controls which are separated from the controlled device will be mounted in a control cabinet or electrical trough that is accessible without a ladder. This does not include sensors or transmitters which must be installed in a pipe.
 22. Each controller panel will have a light switch/110v outlet combination installed. The switch will power down all the transformers in the panel. The 110v outlet will remain powered up with the switch off.
 23. The following wire types will be used for the shown functions:
 - a. Cable Function CSI Part # Jacket Color Description
 24. All wiring in control panels will be installed in open slot wiring duct with snap on covers (Panduit or equal). The panels will be large enough to accommodate all of the hardware without over-crowding.
 25. Each controller will have separate controller power and output power transformers.
 26. A copy of the controls as-built (record) will be furnished in Visio format on CD or DVD.
 27. Two hard copies of the controls as-built (record) will also be furnished.
 28. Space temperature sensor shall be determined and approved by UNT for color and type- Submit samples. Non-Occupant Controlled and No Display
 29. Graphic pages to follow Vista/NSP standards version 5.x or higher.
 30. Wireless networks shall not be used. All networks shall be hardwired and a static IP address will be required by UNT.
 31. Five year plan and system design required for approval.
 32. Programming logic to be approved by UNT personnel. Generally, logic will be designed with as few calculations as necessary to accomplish tasks. Prefer use of modules over calculations.
 33. Equipment network gateway to be fully functional. Contractor will be responsible for this complete functionality.
 34. Hand held device set up will be standardized with Graphics compatible and resolution for devices such as laptops, net books, smart phones, etc.
 - a. A standard controller cabinet, mounting, color, labeling, lighting and location design and instructions will be provided by UNT or designated representative.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control systems. An operator workstation permits interface with the network via dynamic color graphics with each system, building floor plan, and control device depicted by point-and-click graphics.
- D. Power for control panels have been shown on the electrical drawings. The electrical contractor will provide the power to the junction box as indicated. The controls contractor shall furnish and install from the junction box to control panel or device as needed. If additional power is needed for any controls device then the controls contractor shall provide power (wire, conduit, etc.) from an available spare breaker to the controls device requiring 120V. Refer to division 26 for product and installation requirements. The circuit number used shall be submitted along with the required shop drawings to the engineer.
- E. Data for control panels have been shown on the electrical drawings. If additional data drops are needed for any control device than the controls contractor shall provide the remaining devices and cabling to complete the required BAS Ethernet network. Refer to Division 28 for product and installation requirements.

- F. Control system shall include the following:
1. Building lighting control system specified in Division 26 Section "Network Lighting Controls."
 2. Fire alarm system specified in Division 28 Section "Fire Detection and Alarm."

2.02 DDC EQUIPMENT

- A. Operator Workstation: One desktop with configuration commercially available three months before substantial completion:
1. Motherboard with 8 integrated USB 2.0 ports, integrated Intel Ethernet, integrated audio, bios, and hardware monitoring.
 2. Intel Processor:
 3. Random-Access Memory.
 4. Graphics Video Adapter
 5. Monitor 19" LCD color.
 6. Keyboard: QWERTY, 105 keys in ergonomic shape.
 7. Hard-Disk Drive.
 8. CD-ROM Read/Write Drive.
 9. Mouse: Three button, optical.
 10. 2 kVA UPS.
 11. Operating System: Microsoft Windows or Vista with high-speed Internet access.
 - a. Protocol Compliance: Control units shall use BACnet or Modbus protocol.
 12. Printer: Color, ink-jet type commercial printer with print speed of 12 color pages per minute.
 13. Application Software:
 - a. I/O capability from operator station.
 - b. System security for each operator via software password and access levels.
 - c. Automatic system diagnostics; monitor system and report failures.
 - d. Database creation and support.
 - e. Automatic and manual database save and restore.
 - f. Dynamic color graphic displays with up to 10 screen displays at once.
 - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
 - h. Alarm processing, messages, and reactions.
 - i. Trend logs retrievable in spreadsheets and database programs.
 - j. Alarm and event processing.
 - k. Object and property status and control.
 - l. Automatic restart of field equipment on restoration of power.
 - m. Data collection, reports, and logs. Include standard reports for the following:
 - 1) Current values of all objects.
 - 2) Current alarm summary.
 - 3) Disabled objects.
 - 4) Alarm lockout objects.
 - 5) Logs.
 - n. Custom report development.
 - o. Utility and weather reports.
 - p. Workstation application editors for controllers and schedules.
 - q. Maintenance management.
 14. Custom Application Software:
 - a. English language oriented.
 - b. Full-screen character editor/programming environment.
 - c. Allow development of independently executing program modules with debugging/simulation capability.
 - d. Support conditional statements.
 - e. Support floating-point arithmetic with mathematic functions.

- f. Contains predefined time variables.
- B. One Diagnostic Terminal Unit: Portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network with state of the art configuration, commercially available three months before substantial completion.
1. System: With one integrated USB 2.0 port, integrated Intel Ethernet, integrated audio, bios, and hardware monitoring.
 2. Processor: Intel.
 3. Random-Access Memory.
 4. Graphics: Video adapter.
 5. Monitor: 17 inches (431.8 mm), LCD color.
 6. Keyboard: QWERTY 105 keys in ergonomic shape.
 7. Hard-Disk Drive.
 8. CD-ROM Read/Write Drive.
 9. Pointing Device, Touch pad.
- C. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 3. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
 - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - e. Remote communications.
 - f. Maintenance management.
 - g. Units of Measure: Inch-pound and SI (metric).
 4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 5. Protocol Compliance: Control units shall use BACmet or Modbus protocol.
- D. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.

- b. Discrete/digital, analog, and pulse I/O.
- c. Monitoring, controlling, or addressing data points.
3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- E. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
 1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- F. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
 1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- G. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
 1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.03 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 4. Protocol Compliance: Communicate using BACNet or Modbus..
 5. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
 6. Enclosure: If outdoors or in wet ambient conditions, waterproof rated for operation at 40 to 150 deg F (5 to 149 degrees Fahrenheit (65 degrees Celsius)).

2.04 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

- B. Thermistor Temperature Sensors and Transmitters:
1. Accuracy: Plus or minus 0.5 deg F (0.3 deg C) at calibration point.
 2. Wire: Twisted, shielded-pair cable.
 3. Insertion Elements in Ducts: Single point, use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
 4. Averaging Elements in Ducts: Use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Exposed.
 - b. Set-Point Indication: Exposed.
 - c. Temperature: LED.
 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. RTDs and Transmitters:
1. Accuracy: Plus or minus 0.2 percent at calibration point.
 2. Wire: Twisted, shielded-pair cable.
 3. Insertion Elements in Ducts: Single point; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
 4. Averaging Elements in Ducts: Use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
 5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
- D. Humidity Sensors: Bulk polymer sensor element.
1. Accuracy: 2 percent full range with linear output.
 2. Room Sensor Range: 20 to 80 percent relative humidity.
 3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 4. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
 5. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F (0 to 50 deg C).
 6. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- E. Pressure Transmitters/Transducers:
1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: plus/minus 0- to 0.25-inch wg (0 to 62 Pa). Building static sensor shall be bi-directional.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
 4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.05 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (413.69 kPa), piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.06 GAS DETECTION EQUIPMENT

- A. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F (0 to 40 deg C); with 2 factory-calibrated alarm levels at 50 and 100 ppm.
- B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.
- C. Oxygen Sensor and Transmitter: Single detectors using solid-state zircon cell sensing; suitable over a temperature range of minus 32 to plus 1100 deg F (0 to 593 deg C) and calibrated for 0 to 5 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.

2.07 FLOW MEASURING STATIONS

- A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.
 1. Casing: Galvanized-steel frame.
 2. Flow Straightener: Aluminum honeycomb, 3/4-inch (20-mm) parallel cell, 3 inches (76.2 mm) deep.
 3. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

2.08 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 inch (3810 mm). x lbf (16.9 N x m) and breakaway torque of 300 inch (7620 mm). x lbf (33.9 N x m).
 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 inch (3810 mm). x lbf (16.9 N x m).
 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 inch (3810 mm). x lbf (16.9 N x m) and breakaway torque of 300 inch (7620 mm). x lbf (33.9 N x m).
 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 inch (3810 mm). x lbf (16.9 N x m).
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 2. Dampers: Size for running torque calculated as follows:
 - a. Opposed-Blade Damper with Edge Seals: 5 inch (127 mm)-lb/sq. ft. (62 kg-cm/sq. m) of damper.
 - b. Opposed-Blade Damper without Edge Seals: 3 inch (76.2 mm)-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
 - c. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 14.22 yard (13 meter)/s): Increase running torque by 1.5.
 - d. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 16.4 yard (15 meter)/s): Increase running torque by 2.0.
 3. Coupling: V-bolt and V-shaped, toothed cradle.
 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 6. Power Requirements (Two-Position Spring Return): 24-Vac.
 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 9. Temperature Rating: Minus 0 degrees to plus 122 deg F.
 10. Actuator Housing: Molded or die-cast zinc or aluminum.

2.09 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 (DN 50) and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 4. Sizing: 5-psig (35-kPa) Insert value maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.
 - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.

- c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
 5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- C. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Lug.
 2. Disc Type: Aluminum bronze or elastomer-coated ductile iron.
 3. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.
- D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig (861.84 kPa) and 250 deg F (121 deg C) operating conditions.
 2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
 3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.10 DAMPERS

- A. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (203.2 mm) and length of 48 inches (1219.2 mm).
1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
 3. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 inch (1270 mm). x lbf (5.6 N x m); when tested according to AMCA 500D.
 4. Dampers shall be Ruskin CD-50 or approved equal.

2.11 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that power supply is available to control units and operator workstation.

3.02 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.

- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1219.2 mm) above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- E. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- F. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- G. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- H. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- I. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- J. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.03 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.

5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.
- C. DDC Verification:
 1. Verify that instruments are installed before calibration, testing, and loop checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 6. Check temperature instruments and material and length of sensing elements.
 7. Check control valves. Verify that they are in correct direction.
 8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 9. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.
- E. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.05 ADJUSTING

- A. Calibrating and Adjusting:
 1. Calibrate instruments.
 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 4. Control System Inputs and Outputs:
 - a. Check digital inputs using jumper wire.
 - b. Check digital outputs using ohmmeter to test for contact making or breaking.
 - c. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open

and closed.

9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

- B. Adjust initial temperature and humidity set points.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."
- B. Provide a minimum of 40 hours instruction to owner's personnel in the operation and maintenance of the control system. Training sessions shall be video taped by the EMS contractor and tapes/digital files turned over to owner at completion of training.

END OF SECTION

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**SECTION 23 1123
NATURAL GAS 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. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.
 - 6. Mechanical sleeve seals.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, 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.

1.04 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 3. Pressure regulators. Indicate pressure ratings and capacities.
 - 4. Dielectric fittings.
 - 5. Mechanical sleeve seals.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
 - 1. Shop Drawing Scale: 1/4 inch (6.35 mm) per foot (1:50).
 - 2. Detail mounting, supports, and valve arrangements for pressure regulator assembly.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. 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.

- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.07 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
 - 6. Mechanical Couplings:
 - a. Steel flanges and tube with epoxy finish.
 - b. Buna-nitrile seals.
 - c. Steel bolts, washers, and nuts.
 - d. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - e. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
- B. PE Pipe: ASTM D 2513, SDR 11.
 - 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 - 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or flanged or suitable for welded connection.
 - e. Tracer wire connection.

- f. Ultraviolet shield.
- g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
4. Transition Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet shall be threaded or flanged or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
5. Plastic Mechanical Couplings, NPS 1-1/2 (DN 40) and Smaller: Capable of joining PE pipe to PE pipe.
 - a. PE body with molded-in, stainless-steel support ring.
 - b. Buna-nitrile seals.
 - c. Acetal collets.
 - d. Electro-zinc-plated steel stiffener.
6. Plastic Mechanical Couplings, NPS 2 (DN 50) and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - a. Fiber-reinforced plastic body.
 - b. PE body tube.
 - c. Buna-nitrile seals.
 - d. Acetal collets.
 - e. Stainless-steel bolts, nuts, and washers.
7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - a. Steel flanges and tube with epoxy finish.
 - b. Buna-nitrile seals.
 - c. Steel bolts, washers, and nuts.
 - d. Factory-installed anode for steel-body couplings installed underground.

2.02 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 4. Corrugated stainless-steel tubing with polymer coating.
 5. Operating-Pressure Rating: 0.5 psig (0.00 kPa).
 6. End Fittings: Zinc-coated steel.
 7. Threaded Ends: Comply with ASME B1.20.1.
 8. Maximum Length: 72 inches (1828.8 mm).
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 1. Copper-alloy convenience outlet and matching plug connector.
 2. Nitrile seals.
 3. Hand operated with automatic shutoff when disconnected.
 4. For indoor or outdoor applications.
 5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig (861.84 kPa).
- D. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig (861.84 kPa).
- E. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 2. End Connections: Grooved ends.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
 4. CWP Rating: 750 psig (5171.07 kPa).
- F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.03 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.04 MANUAL GAS SHUTOFF VALVES

- A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 1. CWP Rating: 125 psig (861.84 kPa).
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25.4 mm) and smaller.
 6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
 1. CWP Rating: 125 psig (861.84 kPa).
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Brass Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane.
 - b. NIBCO.
 - c. Milwaukee.
 2. Body: Brass, complying with ASTM B 283.
 3. Ball: Chrome-plated brass.
 4. Stem: Brass; blowout proof.
 5. Seats: Reinforced PTFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
 8. CWP Rating: 600 psig (4136.86 kPa).
 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
 2. Body: Cast iron, complying with ASTM A 126, Class B.
 3. Plug: Bronze or nickel-plated cast iron.
 4. Seat: Coated with thermoplastic.
 5. Stem Seal: Compatible with natural gas.
 6. Ends: Threaded or flanged as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
 7. Operator: Square head or lug type with tamperproof feature where indicated.
 8. Pressure Class: 125 psig (861.84 kPa).
 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. PE Ball Valves: Comply with ASME B16.40.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kerotest Manufacturing Corp.
 - b. Lyall, R. W. & Company, Inc.
 - c. Perfection Corporation; a subsidiary of American Meter Company.
 2. Body: PE.
 3. Ball: PE.
 4. Stem: Acetal.
 5. Seats and Seals: Nitrile.
 6. Ends: Plain or fusible to match piping.
 7. CWP Rating: 80 psig (551.58 kPa).
 8. Operating Temperature: Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C).
 9. Operator: Nut or flat head for key operation.
 10. Include plastic valve extension.
 11. Include tamperproof locking feature for valves where indicated on Drawings.

2.05 PRESSURE REGULATORS

- A. General Requirements:
1. Single stage and suitable for natural gas.
 2. Steel jacket and corrosion-resistant components.
 3. Elevation compensator.

4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.
- B. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Eclipse Combustion, Inc.
 - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - e. Invensys.
 - f. Maxitrol Company.
 - g. Richards Industries; Jordan Valve Div.
 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 6. Orifice: Aluminum; interchangeable.
 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 10. Overpressure Protection Device: Factory mounted on pressure regulator.
 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
- C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
 2. Body and Diaphragm Case: Die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber.
 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

2.06 DIELECTRIC FITTINGS

- A. Dielectric Unions:
1. Minimum Operating-Pressure Rating: 150 psig (1034.21 kPa).
 2. Combination fitting of copper alloy and ferrous materials.
 3. Insulating materials suitable for natural gas.
 4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.
- B. Dielectric Flanges:
1. Minimum Operating-Pressure Rating: 150 psig (1034.21 kPa).
 2. Combination fitting of copper alloy and ferrous materials.

3. Insulating materials suitable for natural gas.
4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.07 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.08 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.09 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (152.4 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (762 mm) deep; colored yellow.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.03 OUTDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches (914.4 mm) below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
 1. If natural-gas piping is installed less than 36 inches (914.4 mm) below finished grade, install it in containment conduit. UNT Guidelines say all utilities shall be 36" or more below grade. Any exception to this should be approved by UNT.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 3. Replace pipe having damaged PE coating with new pipe.
- E. Install fittings for changes in direction and branch connections.

- F. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (152.4 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (152.4 mm) and larger in diameter.
- G. 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.
- H. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.04 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install escutcheons at penetrations of interior walls, ceilings, and floors.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- M. Verify final equipment locations for roughing-in.
- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (76.2 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

- R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- T. Connect branch piping from top or side of horizontal piping.
- U. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- V. Do not use natural-gas piping as grounding electrode.
- W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.05 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- C. Install anode for metallic valves in underground PE piping.

3.06 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 2. Cut threads full and clean using sharp dies.
 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.

5. 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.
- D. Welded Joints:
 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 2. Bevel plain ends of steel pipe.
 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.07 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438.4 mm); minimum rod size, 3/8 inch (9.52 mm).
 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743.2 mm); minimum rod size, 3/8 inch (9.52 mm).
 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743.2 mm); minimum rod size, 3/8 inch (9.52 mm).
 4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (304.8 cm); minimum rod size, 1/2 inch (12.7 mm).
 5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (304.8 cm); minimum rod size, 5/8 inch (15.88 mm).

3.08 CONNECTIONS

- A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1828.8 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.09 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches (304.8 mm) below finished grade, except 6 inches (152.4 mm) below subgrade under pavements and slabs.

3.10 PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
 - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
- B. Aboveground natural-gas piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints (2" and smaller).
 - 2. Steel pipe with wrought-steel fittings and welded joints (larger than 2").

3.11 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for line pressure of 1 psig (6.89 kPa) to 5 psig (34.47 kPa) shall be two-piece, full port, brass ball valves. Provide valves rated for outdoor use as needed.
- B. Valves for low pressure applications and equipment connections shall be lubricated plug valves.
- C. Below grade PE distribution piping valves shall be PE ball valves.

3.12 TESTING

- A. By UNT Design Guidelines, natural gas shall be tested at twice the working pressure, with a minimum of 3 psig (20.68 kPa).

END OF SECTION

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**SECTION 23 2113
HYDRONIC PIPING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASME B31.1 - Power Piping; 2024.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Makeup-water piping.
 - 4. Condensate-drain piping.
 - 5. Blowdown-drain piping.
 - 6. Air-vent piping.
 - 7. Safety-valve-inlet and -outlet piping.
 - 8. Chemical treatment.
 - 9. Hydronic specialties.
- B. Related Sections include the following:
 - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.04 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-Water Heating Piping: 150 psig (1034.21 kPa) at 200 deg F (93 deg C).
 - 2. Chilled-Water Piping: 150 psig (1034.21 kPa) at 200 deg F (93 deg C).
 - 3. Condensate-Drain Piping: 150 deg F (66 deg C).
 - 4. Blowdown-Drain Piping: 200 deg F (93 deg C).
 - 5. Air-Vent Piping: 200 deg F (93 deg C).
 - 6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.05 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pressure-seal fittings.
 - 2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 3. Air control devices.
 - 4. Chemical treatment.
 - 5. Hydronic specialties.
- B. Shop Drawings: Detail, at 1/4 (1:50) scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Welding certificates.
- D. Qualification Data: For Installer.
- E. Field quality-control test reports.

- F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
- G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 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.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. 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 01.

1.07 EXTRA MATERIALS

- A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.
- B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 PRODUCTS

2.01 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
- E. Wrought-Copper Unions: ASME B16.22.

2.02 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article. Piping shall be Schedule 40, U.S. domestic only. Foreign manufactured piping will not be accepted.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, Class 300 wall thickness to match adjoining pipe.

- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company of America.
 - b. Grinnell.
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- I. Steel Pressure-Seal Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company of America.
 - b. Grinnell.
 - 2. Housing: Steel.
 - 3. O-Rings and Pipe Stop: EPDM.
 - 4. Tools: Manufacturer's special tool.
 - 5. Minimum 300-psig (2070-kPa) working-pressure rating at 230 deg F (110 deg C).
- J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.03 PRE-INSULATED PIPING

- A. General
 - 1. Pre-insulated Piping – furnish a complete HDPE jacketed system of factory pre-insulated steel piping for the specified service. The jacket throughout the entire system shall incorporate electric fusion, butt fusion, or extrusion welding at all fittings, joint closures, or other points of connection. This shall create a jacket that is seamless throughout the entire system with the exception of anchors, whose water shed rings are sealed with a Raychem Dirax or Canusa GTS-65 wrap prohibiting the ingress of water. If leak detection is required the system shall incorporate a copper wire, as specified below, to make the system leak detection ready. All pre-insulated pipe, fittings, insulating materials, and technical support shall be provided by the pre-insulated piping system manufacturer.
 - 2. A complete layout of the system, showing anchors, expansion provisions, and building entrance details, shall be provided by the pre-insulated pipe manufacturer. Means for expansion must be made in pipe offsets or loops. The system shall be pre-fabricated and pre-engineered to minimize the number of field welds.
 - 3. The system shall be FERRO-THERM as manufactured by Thermacor Process, L.P., of Ft. Worth, Texas.
- B. Carrier pipe shall be steel ASTM A-53, Grade B., ERW (Type E) or seamless (Type S), standard weight, Schedule 40. When practical, piping shall be provided in 40-foot double random lengths. All carbon steel pipe shall have ends cut square and beveled for butt-welding. Straight sections of factory-insulated pipe shall have 6" of exposed pipe at each end for field joint fabrication.

- C. Insulation shall be polyurethane foam either spray applied or high pressure injected with one shot into the annular space between carrier pipe and jacket. Insulation shall be rigid, 90%-95% closed cell polyurethane with a 2.0 to 3.0 lbs. per cubic foot density and coefficient of thermal conductivity (K-factor) of 0.15 @ 75 degrees Fahrenheit (23.89 degrees Celsius). and shall conform to ASTM C-591. Maximum operating temperature shall not exceed 250 degrees Fahrenheit (121.11 degrees Celsius). Insulation thickness shall be specified by calling out appropriate carrier pipe and jacket size combinations as listed on Drawing FTSG 7.103.
- D. Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a minimum wall thickness of 125 mils (3.17501 mm). The jacket throughout the entire system shall incorporate electric fusion, butt fusion, or extrusion welding at all fittings, joint closures, or other points of connection. This shall create a jacket that is seamless throughout the entire system with the exception of anchors, whose water shed rings are sealed with a Raychem Dirax or Canusa GTS-65 wrap prohibiting the ingress of water. The inner surface of the HDPE jacket shall be oxidized by means of corona treatment, flame treatment (patent pending), or other approved methods. This will ensure a secure bond between the jacket and foam insulation, preventing any ingress of water at the jacket/foam interface.
- E. Straight run joints are insulated using polyurethane foam to the thickness specified, jacketed with a full length HDPE sleeve that incorporates electro-fusion welding at all seams to create a pressure testable joint closure, a Canusa pressure testable Supercase closure, or Raychem Rayjoint pressure testable closure. The joint will be pressure tested at 5 psi (34.47 kPa) for 5 minutes while simultaneously soap tested at the joint closure's seams for possible leaks. After passing the pressure test, the field joint is insulated and a closure plug is frictionally welded (as per specified joint closure instructions) over the foam holes. All joint closures and insulation shall occur at straight sections of pipe.
- F. Fittings are factory pre-fabricated and pre-insulated with polyurethane foam to the thickness specified and jacketed with a one-piece seamless molded HDPE fitting cover, a butt fusion welded, or an extrusion welded and mitered HDPE jacket. NO TAPING OR HOT AIR WELDING SHALL BE ALLOWED. All fitting jackets/covers shall be connected to the straight lengths of pipe by electrofusion, butt fusion, or extrusion welding. Carrier pipe fittings shall be butt-welded. Fittings include expansion loops, elbows, tees, reducers, and anchors. Elbows, loops, offsets, or any other direction changes shall conform to the standards set by ASME B31.1, Code for Power Piping.
- G. Expansion/contraction compensation will be accomplished utilizing factory pre-fabricated and pre-insulated expansion elbows, Z-bends, expansion loops, and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pads (minimum one-inch thickness), extending on either side, both inside and outside the radius of the fittings used, with all fittings having expansion in excess of 1/2".
- H. Pre-engineered systems shall be provided with all straight pipe and fittings factory pre-insulated and pre-fabricated to job dimensions.

2.04 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 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.
- 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 D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.05 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions, Flanges, Couplings and Nipples:
 - 1. Refer to Division 22, "Domestic Water Piping Specialties" for products.

2.06 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - 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 (861.84 kPa).
 - 10. Maximum Operating Temperature: 250 deg F (121 deg C).
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company of America.
 - h. Grinnell
 - 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 (861.84 kPa).
 11. Maximum Operating Temperature: 250 deg F (121 deg C).
- E. Automatic Flow-Control Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flow Design Inc.
 - b. Griswold Controls.
 2. Body: Brass or ferrous metal.
 3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
 4. Combination Assemblies: Include bronze or brass-alloy ball valve.
 5. Identification Tag: 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.
 8. Minimum CWP Rating: 175 psig (1206.58 kPa) (300 psi (2070 kPa)).
 9. Maximum Operating Temperature: 250 deg F (121 deg C).
- F. Pressure Independent Control Valve/Flow Limiter:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bell & Gossett
 2. Body: Brass or ductile iron.
 3. Ball & Stem: Stainless steel.
 4. Valve Assembly: Field adjustable, lockable dial with 100% authority at all times. Provide full stroke control regardless of the GPM dial setting.
 5. Actuator: 0 – 10V modulation.
 6. Accessories: Extended temperature/pressure ports.
 7. Performance: Maintain constant flow, plus or minus 5% of GPM setting, within the valve's operating range.
 8. Minimum CWP rating: 360 psig (2482.11 kPa).
 9. Maximum operating temperature: 248 degrees Fahrenheit (120 degrees Celsius).

2.07 AIR CONTROL DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amtrol, Inc.
 2. Armstrong Pumps, Inc.
 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 4. Taco.
- B. Manual Air Vents:
1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or thumbscrew.
 4. Inlet Connection: NPS 1/2 (DN 15).
 5. Discharge Connection: NPS 1/8 (DN 6).
 6. CWP Rating: 150 psig (1034.21 kPa).
 7. Maximum Operating Temperature: 225 deg F (107 deg C).
- C. Automatic Air Vents:
1. Body: Bronze or cast iron.
 2. Internal Parts: Nonferrous.
 3. Operator: Noncorrosive metal float.

4. Inlet Connection: NPS 1/2 (DN 15).
 5. Discharge Connection: NPS 1/4 (DN 8).
 6. CWP Rating: 150 psig (1034.21 kPa).
 7. Maximum Operating Temperature: 240 deg F (116 deg C).
- D. Diaphragm-Type Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
 3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
- E. Tangential-Type Air Separators:
1. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
 2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
 3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
 4. Blowdown Connection: Threaded.
 5. Size: Match system flow capacity.
- F. In-Line Air Separators:
1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
 2. Maximum Working Pressure: Up to 175 psig (1206.58 kPa).
 3. Maximum Operating Temperature: Up to 300 deg F (149 deg C).
- G. Air Purgers:
1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
 2. Maximum Working Pressure: 150 psig (1034.21 kPa).
 3. Maximum Operating Temperature: 250 deg F (121 deg C).

2.08 CHEMICAL TREATMENT

- A. Bypass Chemical Feeder: Welded steel construction; 175-psig and 250 degrees Fahrenheit (121.11 degrees Celsius) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves. Provide Garrett-Callahan Co. Model #5018.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment. Perform a water analysis and provide adequate treatment for the systems indicated on the drawings.
- B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.09 HYDRONIC PIPING SPECIALTIES

- A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged or grooved ends for NPS 2-1/2 (DN 65) and larger.
 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig (861.84 kPa).
- B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig (861.84 kPa).
- C. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 2. End Connections: Grooved ends.
 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
 4. CWP Rating: 750 psig (5171.07 kPa).
- D. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
 2. End Connections: Threaded or flanged to match equipment connected.
 3. Performance: Capable of 3/4-inch (20-mm) misalignment.
 4. CWP Rating: 150 psig (1034.21 kPa).
 5. Maximum Operating Temperature: 250 deg F (121 deg C).
- E. Spherical, Rubber, Flexible Connectors:
1. Body: Fiber-reinforced rubber body.
 2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
 3. Performance: Capable of misalignment.
 4. CWP Rating: 150 psig (1034.21 kPa).
 5. Maximum Operating Temperature: 250 deg F (121 deg C).
- F. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:
1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 2. Schedule 40 black steel pipe; Class 2000 PSI, malleable-iron or cast iron fittings; threaded fittings.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:
1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 2. Schedule 40 black steel pipe; Class 2000 PSI, butt welding fittings. Mechanically grooved-end fittings and couplings may be used in mechanical rooms.
 3. Grooved type couplings and fittings may not be used at risers or concealed areas.
- C. Chilled-water piping, aboveground, NPS 2 (DN 50) and smaller, shall be the following:
1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- D. Chilled-water piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:
1. Schedule 40 through 10-inch and 30 above 10-inch steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

2. Schedule 40 through 10-inch and 30 above 10-inch steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- E. Chilled-water piping installed below grade, within the building perimeter, within sleeves shall be the following:
 1. Type K (A), annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use tubing without joints.
- F. Hot or chilled water piping belowground shall be:
 1. Pre-insulated piping with steel carrier pipe, polyurethane insulation and HDPE jacketing, designed for direct-buried installation.
- G. Makeup-water piping installed aboveground shall be the following:
 1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- H. Makeup-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- I. Condensate-Drain Piping: Type M (C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- J. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- K. Air-Vent Piping:
 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.
- L. 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 the piping manufacturer's written instructions.

3.02 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, automatic flow-control, or pressure independent control valve/flow limiter where detailed on the drawings. Refer to drawings/details for specific installation of each type of valve. At a minimum, install flow control valves:
 1. At each branch connection to return main.
 2. In the return pipe of each heating or cooling terminal.
 3. Refer to drawings/details for specific installation of each type of valve.
- C. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- D. 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; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.03 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
- U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- V. B.A.S. temperature control devices requiring installation in piping such as motorized valves, sensors, etc., shall be installed by mechanical contractor.
- W. Pre-insulated below grade piping:
 - 1. Underground systems shall be buried in a trench not less than two feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches (609.6 mm) of compacted backfill placed over the top of the pipe will meet H-20 highway loading. The minimum cover on top of piping shall be 36".
 - 2. Backfilling shall be done with sand 6" below the casing and 1' above. Engineer-approved backfill may be used to fill the rest of the trench. This material should be free of rocks, roots, large clods, or anything that could cause damage to the jacket.
 - 3. A hydrostatic pressure test of the carrier pipe shall be performed per the engineer's specification with a factory recommendation of one and one-half times the normal system operating pressure for not less than two hours. Prior to testing, field verify central plant working pressure. Care shall be taken to insure all trapped air is removed from the

system prior to the test. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.

4. Field service is required and will be provided by a certified manufacturer's representative or company field service technician. The technician will be available at the job a minimum of one day (or more if required by job size) to check unloading, storing, and handling of pipe, pipe installation, pressure testing, field joint insulation, and backfilling techniques.

3.04 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (609.6 cm) long.
 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (609.6 cm) or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (609.6 cm) 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.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4 (DN 20): Maximum span, 7 feet (213.36 cm); minimum rod size, 3/8 inch (9.52 mm).
 2. NPS 1 (DN 25): Maximum span, 7 feet (213.36 cm); minimum rod size, 3/8 inch (9.52 mm).
 3. NPS 1-1/4 (DN 32): Maximum span, 7 feet (213.36 cm); minimum rod size, 3/8 inch (9.52 mm).
 4. NPS 1-1/2 (DN 40): Maximum span, 9 feet (274.32 cm); minimum rod size, 3/8 inch (9.52 mm).
 5. NPS 2 (DN 50): Maximum span, 10 feet (304.8 cm); minimum rod size, 3/8 inch (9.52 mm).
 6. NPS 2-1/2 (DN 65): Maximum span, 11 feet (335.28 cm); minimum rod size, 1/2 inch (12.7 mm).
 7. NPS 3 (DN 80): Maximum span, 12 feet (365.76 cm); minimum rod size, 1/2 inch (12.7 mm).
 8. NPS 3-1/2 (DN 90): Maximum span, 13 feet (396.24 cm); minimum rod size, 1/2 inch (12.7 mm).
 9. NPS 4 (DN 100): Maximum span, 14 feet (426.72 cm); minimum rod size, 5/8 inch (15.88 mm).
 10. NPS 5 (DN 125): Maximum span, 16 feet (487.68 cm); minimum rod size, 5/8 inch (15.88 mm).
 11. NPS 6 (DN 150): Maximum span, 17 feet (518.16 cm); minimum rod size, 3/4 inch (19.05 mm).
 12. NPS 8 (DN 200): Maximum span, 19 feet (579.12 cm); minimum rod size, 3/4 inch (19.05 mm).
 13. NPS 10 (DN 250): Maximum span, 22 feet (670.56 cm); minimum rod size, 7/8 inch (22.22 mm).
 14. NPS 12 (DN 300): Maximum span, 23 feet (701.04 cm); minimum rod size, 7/8 inch (22.22 mm).
 15. NPS 14 (DN 350): Maximum span, 25 feet (762 cm); minimum rod size, 1 inch (25.4 mm).
 16. NPS 16 (DN 400): Maximum span, 27 feet (822.96 cm); minimum rod size, 1 inch (25.4 mm).

17. NPS 18 (DN 450): Maximum span, 28 feet (853.44 cm); minimum rod size, 1 inch (25.4 mm).
 18. NPS 20 (DN 500): Maximum span, 30 feet (914.4 cm); minimum rod size, 1-1/4 inches (32 mm).
- D. Install hangers for drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 5 feet (152.4 cm); minimum rod size, 3/8 inch (9.52 mm).
 2. NPS 1 (DN 25): Maximum span, 6 feet (182.88 cm); minimum rod size, 3/8 inch (9.52 mm).
 3. NPS 1-1/4 (DN 32): Maximum span, 7 feet (213.36 cm); minimum rod size, 3/8 inch (9.52 mm).
 4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (243.84 cm); minimum rod size, 3/8 inch (9.52 mm).
 5. NPS 2 (DN 50): Maximum span, 8 feet (243.84 cm); minimum rod size, 3/8 inch (9.52 mm).
- E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.05 PIPE 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/D10.12M, 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.
- I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- K. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.06 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1219.2 mm) above the floor. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 (DN 20) pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- 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 tank is properly charged with air to suit system Project requirements.
- I. Strainer Schedule:

	Cast Iron		Steel		Bronze	
	Y	Basket	Y	Basket	Y	Basket
Steel/Iron Piping Systems	Mueller Manufacturer's Number					
150 psig (1034.21 kPa) & less						
2-1/2" & smaller	11	145	--	--	--	--
3" thru 12"	751	165	--	--	--	--
14" thru 24"	752	166	--	--	--	--
151 thru 400 psig (2757.90 kPa):						
2-1/2" & smaller	11	--	--	--	--	--
3" thru 12"	752	--	--	--	--	--
14" thru 24"	--	--	762	186	--	--
401 thru 700 psig (4826.33 kPa):						

kPa):						
2-1/2" & smaller	--	--	861	--	--	--
3" thru 20"	--	--	764	186	--	--
	Cast Iron		Steel		Bronze	
	Y	Basket	Y	Basket	Y	Basket
Copper Piping Systems	Mueller Manufacturer's Number					
3" & smaller:						
150 psig & less	--	--	--	--	352	165B
151 thru 400 psig	--	--	--	--	352	166B

3.07 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.08 CHEMICAL TREATMENT

- A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the water within acceptable limits.
- B. Prepare a formal report detailing the results of the water analysis and proposed water treatment. Maintain a reasonable pH, alkalinity, corrosion inhibitor and microbiological growth.
- C. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.09 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION

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**SECTION 23 3113
METAL DUCTS**

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. Single-wall rectangular ducts and fittings.
 - 2. Double-wall rectangular ducts and fittings.
 - 3. Single-wall round ducts and fittings.
 - 4. Double-wall round ducts and fittings.
 - 5. Sheet metal materials.
 - 6. Duct liner.
 - 7. Sealants and gaskets.
 - 8. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 PERFORMANCE REQUIREMENTS

- A. Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.04 SUBMITTALS

- A. LEED Submittals:
 - 1. Product Data for Prerequisite IEQ-Minimum Indoor Air Quality Performance: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
 - 2. Product Data for Prerequisite EA-Minimum Energy Performance: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
 - 3. Leakage Test Report for Prerequisite EA-Minimum Energy Performance: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
 - 4. Duct-Cleaning Test Report for Prerequisite IEQ-Minimum Indoor Air Quality Performance: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-Up."
 - 5. Product Data for Credit IEQ-Low-Emitting Materials: For adhesives and sealants, including printed statement of VOC content.
- B. Shop Drawings: Detail, 1/4" – 1'-0" scale, the ductwork layout with sizes, configuration, liner material and static pressure classes, elevation of ductwork, reinforcement/spacing, seam and

joint construction, penetrations through fire-rated and other partitions, locations of duct accessories including dampers, turning vanes, access doors and access panels, equipment supports and foundations. Out of scale drawings showing actual dimensions will not be acceptable. Shop drawings shall show coordination with all other building trades.

1.05 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- C. The ductwork shall be guaranteed for a period of one (1) year from and after the date of final acceptance of the job, against noise, chatter, whistling and vibration, and shall be guaranteed to be free from pulsation under all conditions of operation. After each system is in operation, should any of these defects occur, the components in which they occur shall either be removed and replaced or reinforced as directed by the Architect.

PART 2 PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
- F. Inner Duct: Minimum 0.028-inch (0.7-mm) solid sheet steel.
- G. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Traverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- H. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Ducts less than or equal to 1" SMACNA pressure class may be spiral or snap-lock type. Ducts greater than 1" SMACNA pressure class shall all be spiral only.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.04 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements,

materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- B. Inner Duct: Minimum 0.028-inch (0.7-mm) solid sheet steel.
- C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.

2.05 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Unless noted otherwise in these specifications or on the drawings, all ductwork shall be G90 galvanized steel.

2.06 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.
 - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 - 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- B. Closed-Cell Flexible Elastomeric Duct Liner: Comply with ASTM C534, Type I sheet material.
 - 1. Maximum Thermal Conductivity:
 - a. 0.28 Btu in/hr ft² at 75 degrees Fahrenheit (23.89 degrees Celsius), with antimicrobial product protection.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

2.07 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

2.08 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 EXECUTION

3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- D. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- E. Install ducts with a clearance of 1 inch (25.4 mm), plus allowance for insulation thickness.
- F. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures and directly over any electrical panel or transformer.
- G. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- H. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- I. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines", intermediate level of cleanliness.
 - 1. Prevent damage and accumulation of dirt/debris during transportation.
 - 2. Store ducts on the jobsite in an area that is clean, dry and exposure to dust is minimized.
 - 3. Wipe internal surfaces of ductwork immediately prior to installation.
 - 4. Open ends on completed ductwork and overnight work-in-progress shall be sealed, regardless of the position.

3.02 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease. Ducts with horizontal sections 75 feet (2286 cm) or less shall be sloped a minimum of 2 percent to drain grease back to the hood. For ducts greater than 75 feet, horizontal slope a minimum of 8.3 percent.
- B. Install fire-rated access panel assemblies, meeting IMC-2015, at each change in direction (not more than 10 feet (304.8 cm) from change in direction) and at maximum intervals of 20 feet (609.6 cm) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches (38 mm) from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.04 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (101.6 mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (101.6 mm) thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (609.6 mm) of each elbow and within 48 inches (1219.2 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (487.68 cm).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where

used.

3.06 FIELD QUALITY CONTROL

- A. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 6. Give seven days' advance notice for testing.
- B. For all grease ducts perform a light test, per IMC-2015, to determine that all welded joints are liquid tight for the entire duct system. Grease ducts shall be leakage tested for the entire length of the duct system, per SMACNA HVAC Air Duct Leakage Test Manual.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Clean any portion of the duct system that contains dust, dirt or debris.

3.07 DUCT SCHEDULE

- A. Supply Ducts:
 - 1. Ducts Connected to the Discharge Side of Air Terminal Units:
 - a. Pressure Class: Positive 1-inch wg (500 Pa).
 - b. Minimum SMACNA Seal Class: A.
 - c. Minimum SMACNA Leakage Class: 6.
 - 2. Ducts Connected to Low Pressure Constant-Volume AHU, Furnaces and Other Similar Units:
 - a. Pressure Class: Positive 2-inch wg (500 Pa).
 - b. Minimum SMACNA Seal Class: A.
 - c. Minimum SMACNA Leakage Class: 6.
 - 3. Ducts Connected to Medium Pressure Variable-Air-Volume AHU or Fans:
 - a. Pressure Class: Positive 3-inch wg. If the drawings or schedules indicate a duct system operating in excess of 3-inch wg provide SMACNA pressure class 4-inch. (750 Pa)], (1000 Pa)
 - b. Minimum SMACNA Seal Class: A.
 - c. Minimum SMACNA Leakage Class: 6.
- B. Return Ducts:
 - 1. All Return Ducts:
 - a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
 - b. Minimum SMACNA Seal Class: A.
 - c. Minimum SMACNA Leakage Class: 6.
- C. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg (500 Pa).
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - 2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: 18 gauge, Type 304, stainless-steel sheet, minimum.
 - b. Concealed: 16 gauge black steel, minimum.

- c. External welded seams and joints, meeting requirements of IMC 2015.
 - d. Pressure Class: Positive or negative 2-inch wg (500 Pa).
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 3.
3. Ducts Connected to Dishwasher Hoods; Locker rooms, shower areas and associated restrooms; other wet area exhaust systems:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - e. Pressure Class: Positive or negative 2-inch wg (500 Pa).
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
- D. Liner (only where indicated here or on the drawings):
1. Transfer Ducts: Fibrous glass, Type I, 1/2 inch (12.7 mm) thick or Closed-cell elastomeric, 1/2 inch (12.7 mm) thick.
 2. Where liner is used, increase the sheet metal dimensions to allow for the liner thickness. Dimensions on drawings are clear dimensions.
- E. Double-Wall Duct Interstitial Insulation:
1. All ducts shall be insulated per standard requirements to meet IECC 2015.
- F. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Low Pressure (2" and Below)
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - b. Medium Pressure (3" and Higher):
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
- G. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 or higher (5 to 7.6 m/s): Conical tap.
- H. COORDINATION
1. Fire Alarm and B.A.S. Temperature Control devices requiring installation in ductwork such as smoke detectors, air monitors, motorized dampers and sensors shall be installed by the mechanical subcontractor.

END OF SECTION

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**SECTION 23 3300
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. ASTM E477 - Standard Test Method for Laboratory Measurements of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers; 2020.
- C. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- D. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Barometric relief dampers.
 - 3. Manual volume dampers.
 - 4. Fire dampers.
 - 5. Combination fire and smoke dampers.
 - 6. Duct silencers.
 - 7. Turning vanes.
 - 8. Remote damper operators.
 - 9. Duct-mounted access doors.
 - 10. Flexible connectors.
 - 11. Flexible ducts.
 - 12. Duct security bars.
 - 13. Duct accessory hardware.
- B. Related Sections:
 - 1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
 - 2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. LEED Submittal:
 - 1. Product Data for Prerequisite IEQ-Minimum Indoor Air Quality Performance: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

1.05 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise

indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (914.4 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (914.4 mm).

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum System Pressure: As defined by the duct construction requirements.
- D. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum 0.052-inch- (1.3-mm-) with welded corners and mounting flange.
- E. Blades: Multiple single-piece blades, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.
- F. Blade Action: Parallel.
- G. Blade Seals: Neoprene, mechanically locked.
- H. Return Spring: Adjustable tension.
- I. Bearings: Steel ball or synthetic pivot bushings.
- J. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage (1.0-mm) minimum.
 - b. Sleeve Length: 6 inches (152.4 mm) minimum.
 - 6. Screen Mounting: Rear mounted.
 - 7. Screen Material: Aluminum.
 - 8. Screen Type: Insect.
 - 9. 90-degree stops.

2.03 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.

2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Ruskin Company.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum System Pressure: As defined by the duct construction requirements.
- D. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.
- E. Blades:
1. Multiple, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
 2. Maximum Width: 6 inches (152.4 mm).
 3. Action: Parallel.
 4. Balance: Gravity.
 5. Eccentrically pivoted.
- F. Blade Seals: Neoprene.
- G. Return Spring: Adjustable tension.
- H. Accessories:
1. Flange on intake.
 2. Adjustment device to permit setting for varying differential static pressures.

2.04 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
1. Suitable for horizontal or vertical applications.
 2. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 3. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch (1.63 mm) thick.
 4. Bearings:
 - a. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 5. Accessories
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration per UNT Design Guidelines.
- B. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating; a division of Mestek, Inc.
 - b. Nailor Industries Inc.
 - c. Ruskin Company.
 2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Galvanized-steel channels, 0.064 inch (1.63 mm) thick.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:

- a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel, 0.064 inch (1.63 mm) thick.
6. Bearings:
- a. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
7. Blade Seals: Neoprene.
8. Accessories:
- a. Include locking device to hold single-blade dampers in a fixed position without vibration per UNT Design Guidelines.

2.05 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Prefco.
 4. Ruskin Company.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Fire Rating: 1-1/2 or 3 hours, depending upon fire rating equipment of wall or floor assembly.
- D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners. Blades in the airstream are acceptable only in areas where the fire damper is directly preceded by a grille.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch (3.51 mm) thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.06 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Ruskin Company.
- B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4 inch (101.6 mm) w.g. static pressure class and maximum 4000 fpm velocity.
- D. Fire Rating: 1-1/2 or 3 hours, depending upon fire rating requirement of wall or floor assembly.
- E. Frame: Multiple blade type fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

- F. Heat-Responsive Device: Electric, resettable link and switch package, factory installed and tested.
- G. Leakage Class 1 (8cfm/sf @ 4.0" wg.)
- H. Damper Motors: Two-position action.
- I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." and Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 inch (3810 mm). x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 inch (3810 mm). x lbf (17 N x m) and breakaway torque rating of 300 inch (7620 mm). x lbf (34 N x m).
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- J. Accessories:
 - 1. Auxiliary switches for signaling and/or position indication.
 - 2. Test and reset switches, damper mounted.

2.07 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pottorff.
 - 2. IAC.
 - 3. Vibro-Acoustics.
- B. General Requirements:
 - 1. Factory fabricated.
 - 2. Acoustical Performance: Tested in accordance with ASTM E477-99.
 - 3. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
- C. LEED Requirement:
 - 1. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, , galvanized sheet steel, 22 gauge thick.
- E. Inner Casing and Baffles: ASTM A 653/A 653M, galvanized sheet metal, 26 gauge thick, and with 1/8-inch- (3-mm-) diameter perforations.
- F. Connection Sizes: Match connecting ductwork.
- G. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 2. Film-lined type with fill material.
 - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
 3. Lining: Mylar.
- H. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
1. Continuously weld joints.
 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- I. Source Quality Control: Tested in accordance with ASTM E 477.
1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm (10-m/s) face velocity.
 2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg (1500-Pa) static pressure, whichever is greater.

2.08 REMOTE DAMPER OPERATORS

- A. Provide remote damper operators for controlling dampers located above gyp board or other inaccessible ceilings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Pottorff.
 2. Ventfabrics, Inc.
 3. Young Regulator Company.
- C. Description: Cable system designed for remote manual damper adjustment.
- D. Tubing: Brass.
- E. Cable: Stainless steel.
- F. Ceiling Mounting: Coverplate shall be white.

2.09 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches (11.81 inch (300 mm)) Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches (18.11 inch (460 mm)) Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches (600 by 47.24 inch (1200 mm)): Three hinges and two compression latches with outside handles.

- d. Access Doors Larger Than 24 by 48 Inches (600 by 47.24 inch (1200 mm)): Four hinges and two compression latches with outside and inside handles.

2.10 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).
- F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.11 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. SEMCO Incorporated.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 5. AeroDyne Sound Control Co.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall, airfoil shaped.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).

2. Minimum Tensile Strength: 500 lbf/inch (88 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

2.13 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.
- B. Insulated Flexible Duct, Type 1: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 1. Pressure Rating: 4-inch wg (1000 Pa) positive and 1.0-inch wg (250 Pa) negative.
 2. Maximum Air Velocity: 4000 fpm (21.87 yard (20 meter)/s).
 3. Temperature Range: Minus 10 to plus 160 degrees Fahrenheit (71.11 degrees Celsius).
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- C. Insulated Flexible Duct, Type 2: UL 181, Class 1, aluminum flexible duct; fibrous-glass insulation, polyethylene or aluminized vapor-barrier film.
 1. Pressure Rating: 10-inch wg (2500 Pa) positive thru 16" diameter and 12-inch wg (3000 Pa) negative thru 16" diameter.
 2. Maximum Air Velocity: 5500 fpm (30.07 yard (27.5 meter)/s).
 3. Temperature Range: Minus 20 to plus 250 degrees Fahrenheit (121.11 degrees Celsius).
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- D. Flexible Duct Connectors:
 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or nylon strap in sizes 3 through 18 inches (457.2 mm), to suit duct size.

2.14 DUCT SECURITY BARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carnes.
 2. KEES, Inc.
 3. Lloyd Industries, Inc.
 4. Metal Form Manufacturing, Inc.
 5. Price Industries.
- B. Description: Field- or factory-fabricated and field-installed duct security bars.
- C. Configuration:
 1. Frame: 10 gage by 2 inches (50.8 mm).
 2. Sleeve: 3/16-inch (4.8-mm), continuously welded steel frames with 1-by-1-by-3/16-inch (25-by-25-by-4.8-mm) angle frame factory welded to 1 end or furnished loose for field welding on other end. To be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.
 3. Horizontal Bars: 1/2 inch (12.7 mm).
 4. Vertical Bars: 1/2 inch (12.7 mm).
 5. Bar Spacing: 6 inches (152.4 mm).

2.15 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft or control dampers as indicated on the Drawings at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and fire smoke dampers according to UL listing.
- H. Install duct security bars. Construct duct security bars from 0.164-inch (4.18-mm) steel sleeve, continuously welded at all joints and 1/2-inch- (13-mm-) diameter steel bars, 6 inches (152.4 mm) o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch (63-by-63-by-6-mm) steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch (300-by-300-mm) hinged access panel with cam lock in duct in each side of sleeve.
- I. Connect ducts to duct silencers rigidly.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or fire/smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot (15-m) spacing.
 - 8. Upstream and downstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes (minimum sizes)
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 - 5. Body Access: 25 by 14 inches (635 by 355 mm).

- 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.
- O. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect terminal units and other high pressure systems to supply ducts with maximum 12-inch (300-mm) lengths of flexible duct, Type 2. Do not use flexible ducts to change directions.
- Q. Connect diffusers or light troffer boots to ducts with maximum 60-inch (1500-mm) lengths of flexible duct, Type 1, clamped or strapped in place.
- R. Connect flexible ducts to metal ducts with draw bands adhesive and sheet metal screws.
- S. Install duct test holes where required for testing and balancing purposes.
- T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.
- B. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

END OF SECTION

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**SECTION 23 3423
HVAC POWER VENTILATORS**

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. This Section includes the following:
 - 1. Utility set fans.
 - 2. Centrifugal roof ventilators.
 - 3. Centrifugal wall ventilators.
 - 4. In-line centrifugal fans.
 - 5. Propeller fans.
 - 6. Ceiling-mounted ventilators.

1.03 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 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. Belts: One set(s) for each belt-driven unit.

PART 2 PRODUCTS

2.01 UTILITY SET FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the approved manufacturers shown on the drawings.
- B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- C. Housing: Fabricated of steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
 - 1. Housing Discharge Arrangement: Adjustable to eight standard positions.
- D. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
- E. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
- F. Accessories:
 - 1. Inlet and Outlet: Flanged.
 - 2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 - 3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
 - 4. Access Door: Gasketed door in scroll with latch-type handles.
 - 5. Drain Connections: NPS 3/4 (DN 20) threaded coupling drain connection installed at lowest point of housing.
 - 6. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
 - 7. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

2.02 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the approved manufacturers shown on the drawings.
- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
 - 2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 - 2. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
 - 3. Other accessories as listed on the drawing schedule.
- G. Roof Curbs: 12" High Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

2.03 CENTRIFUGAL WALL VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the approved manufacturers shown on the drawings.
- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- D. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
 - 2. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
 - 3. Other accessories as listed on the drawing schedule.

2.04 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the approved manufacturers shown on the drawings.
- B. Description: In-line centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- F. Fan Wheels: Aluminum, backward inclined blades welded to aluminum hub.

2.05 PROPELLER FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the approved manufacturers shown on the drawings.
- B. Description: Direct- or belt-driven propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.
- C. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- D. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- E. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- F. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor Size: 1.4.
 - 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - a. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.
 4. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
 5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- G. Accessories:
1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
 3. Wall Sleeve: Galvanized steel to match fan and accessory size.
 4. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 5. Other accessories as listed on the drawings.

2.06 CEILING-MOUNTING VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the approved manufacturers shown on the drawings.
- B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- C. Housing: Steel, lined with acoustical insulation.
- D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- E. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories:
 1. Accessories as listed in the drawing schedule.

2.07 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Motor controllers, except where they are to be mounted inside a motor control center or specifically identified and scheduled in Division 26 or on the drawings, shall be furnished by the M/C or P/C for installation by the E/C. Refer to Section 220513 for details.

2.08 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install power ventilators level and plumb.

- B. Support units using elastomeric mounts, restrained elastomeric mounts, spring isolators or restrained spring isolators having a static deflection of 1 inch (25.4 mm). Vibration- and seismic-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
 - 1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- F. Install units with clearances for service and maintenance.
- G. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION

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**SECTION 23 3713
DIFFUSERS, REGISTERS, AND GRILLES**

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. Related Sections:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 PRODUCTS

2.01 AIR INLETS AND OUTLETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the approved manufacturers shown on the drawings.
- B. Grilles, registers, ceiling outlets, and ceiling inlets shall be as indicated in the schedule on the Drawings.
- C. Verify the type of ceiling system and material into which each of the air inlets and outlets are to be installed, and provide equipment that properly "fits" whether specifically so indicated or not on the Drawings.

2.02 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

- D. Locations of outlets shown on the drawings are approximate; they shall be coordinated with other trades to make symmetrical patterns, and shall be governed by the established pattern of the lighting fixtures or architectural reflected ceiling plan. Where a reflected ceiling plan is included in the architectural drawings, locations of all devices as shown thereon shall govern.

3.03 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

**SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL**

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. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For sleeve seals.
- B. Shop Drawings: Where not specifically mentioned in subsequent sections, provide drawings for equipment arrangements, terminal boards, large cabinets and enclosures, local communications systems and modular wiring systems.

1.05 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".
- E. Coordinate chases, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follows.
 - 1. Set inserts and sleeves in poured-in place concrete, masonry work, and other structural components as they are constructed.
- F. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- G. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.

2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- H. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- I. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.
- J. In order to make the submittal review process more efficient for all parties, all MEP submittal data shall be reviewed on a designated "Submittal Review Day." The "Submittal Review Day" will consist of having the Engineer, General Contractor, Mechanical Contractor, Plumbing Contractor, and Electrical Contractor review the submittals together, in the same room. The Architect and owner's representative(s) will be invited to attend the "Submittal Review Day." Key Manufacturer's Representatives shall attend the review or be available by phone for immediate response to questions and/or comments. All submittals will be reviewed and stamped by the Engineer the same day. The Contractor is responsible for setting time and place for this review and inviting all required parties. All parties will be given a minimum of seven (7) days notice.

1.06 GENERAL

- A. For Products specified by reference to an association or trade standard, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.
- B. The date of the standard is that in effect on the date of issue of Contract Documents, except when a specific publication date is specified. Obtain copies of referenced standards direct from publication source, when needed for proper performance of Work, or when required for submittal by Contract Documents

1.07 SCHEDULE OF ABBREVIATIONS

- A. Reference standards are listed in various sections using abbreviations contained below:
 - a. ANSI American National Standards Institute
 - 1) ASTM American Society for Testing and Materials
 - (a) EGSM Engine Generator Sales Manufacturers Association
 - (b) ETL Electrical Testing Laboratories
 - 2) ICEA Insulated Cable Engineers Association
 - 3) IEEE Institute of Electrical and Electronic Engineers
 - (a) IES Illuminating Engineering Society
 - (b) NBS National Bureau of Standards
 - (c) NEC National Electrical Code
 - 4) NECA National Electrical Contractors Association
 - 5) NEMA National Electrical Manufacturers' Association
 - 6) NETA International Electrical Testing Association
 - 7) NFPA National Fire Protection Association
 - 8) OSHA Occupation Safety Health Administration
 - 9) UL Underwriters Laboratories

1.08 OPERATION AND CONTROL CHARACTERISTICS OF EQUIPMENT

- A. The operation and control characteristics of each item of equipment scheduled, noted and/or indicated on the plans and specifications are based on a particular manufacturer and model. While other manufacturers or models may be acceptable, it is the responsibility of the Contractor to verify that the operation and controls characteristics for the equipment he proposes to provide match those indicated. In the instance where the equipment he proposes to provide has different operation and controls characteristics, the Contractor AT NO COST TO THE OWNER shall provide the required operation and controls characteristics required. All modifications to provide the operation and control characteristics shall be coordinated by the Contractor with the Engineer.

- B. Motor controllers, except where they are to be mounted inside a motor control center or specifically identified and scheduled in Division 26 or on the drawings, shall be furnished by the M/C or P/C for installation by the E/C. Refer to Section 220513 for details.
- C. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.
- D. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.
- E. The date of acceptance by the Architect, for beneficial use by the Owner, shall be the beginning date of the warranty period.

1.09 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of each item of equipment shown on the Drawings is based on the dimensions of a particular manufacturer, or approximate dimensions for "generic" equipment. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes to furnish will fit into the available space. Shop drawings shall be prepared to indicate a suitable arrangement.
- B. Install equipment in a manner to permit access to all surfaces. Install switches, circuit breakers, relays, ballasts, and other accessory items, and all auxiliary devices in a position to allow removal for service without requiring the disassembly of another part. Alternative arrangements deemed "suitable" must conform to Codes and provide at least as much access and working space clearance as indicated on Bid Drawings.
- C. Large equipment assemblies and components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. Such equipment shall be ordered early on, sufficient to allow arrival for timely installation. Contact the Architect should problems be expected in this regard. The equipment shall be protected until hazards of damage to the equipment, including dust and moisture, are eliminated.

1.10 OPERATING AND MAINTENANCE MANUALS

- A. Manuals shall be submitted which contain the following:
 - 1. Description of the system provided.
 - a. Handling, storage, and installation instructions.
 - b. Detailed description of the function of each principal component of the systems or equipment, including necessary wiring diagrams.
 - 2. Operating procedures:
 - a. Pre startup activities required.
 - b. Startup.
 - c. Normal operation.
 - d. Emergency shutdown.
 - e. Normal shutdown.
 - f. Trouble-shooting guide.
 - 3. Maintenance:
 - a. Preventative and repair maintenance procedures.
 - b. Complete spare parts list with cross reference to original equipment manufacturer part number.
 - 4. Safety and environmental considerations.
 - 5. Other data required elsewhere in the specifications.
- B. Three copies of the manuals shall be provided within sufficient time to allow for training of Owner's personnel. Submit one copy of the manuals to the Architect for review no later than 90 calendar days prior to substantial completion or building turn over, whichever comes first. Submit the remaining three corrected copies within 15 days after review set is returned to

contractor. Progress payment may be withheld if this requirement is not met.

- C. The manuals shall be provided in three-ring side binders with durable plastic covers.
- D. The manuals shall contain a detailed table of contents and have tab dividers for major sections and special equipment.
- E. The Owner will not accept any training or equipment unless the maintenance manuals are received a minimum of 10 working days prior to request for Training/Turnover.

1.11 START-UP EQUIPMENT AND SYSTEMS

- A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer's start-up service (rendered by the manufacturer or his authorized representative) shall be provided.
- B. Witnessing and explanations of start-up services shall be included as part of the "Instruction of Owner's Personnel" as specified below.

1.12 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers or technicians acceptable to the Architect to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals.

1.13 AS-BUILT DRAWINGS

- A. The Contractor shall, during the progress of the job, keep a set of record prints on which he shall mark all changes. After completion of a CADD release form by the Contractor and near the conclusion of the job, the Architect will provide the Contractor with one set of AutoCAD electronic files of the Mechanical, Plumbing, and Electrical Drawings. The Contractor shall draft on these electronic files all changes made during the progress of the work and return them and one set of paper plans with the changes to the Architect as "As-Built Drawings".

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
- B. Each item of equipment furnished on this project shall have local representation, factory-authorized service and an adequate stock of repair parts. "Local" shall be defined, for this purpose, as "within 50 miles (80.47 kilometers) of the project site."

2.02 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (406.4 mm), thickness shall be 0.052 inch (1.32 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (406.4 mm), thickness shall be 0.138 inch (3.51 mm).

2.03 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 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 cable or conduit. Include type and number required for material and size of raceway or cable.
 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.

2.04 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FIRESTOPPING

- A. Provide firestopping in sealing of penetrations in fire-rated construction, horizontal and vertical, including the following materials:
 1. Foam: Dow Corning Firestop silicone RTV foam, liquid component Part A (black) and liquid component Part B (off-white).
 2. Sealant: 3M 1000NS and 1003SL silicone adhesive sealant, single component, neutral cure, and non-slumping.
 3. Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by the applicator.
- B. Mixes shall conform to the manufacturer's directions.

PART 3 EXECUTION

3.01 ELECTRICAL DEMOLITION

- A. Access: Access to and use of the existing facilities and site will be restricted, and shall be under the direction and control of the Owner.
- B. Disruptions: Maintain existing electrical, communications, alarm, and other existing systems, and maintain existing functions in service except for scheduled disruptions. Where existing functions to remain in use are disrupted, they shall be fully restored after disruption, in full compliance with this Division of the Specifications for new work.
- C. Scheduling of Disruptions: Seek and obtain approval two weeks in advance of event for date, starting time, and duration of each required disruption.
- D. Notice of Disruption: Date, time and duration of each disruption shall be subject to the Owner's prior approval, and shall include the following information in the form of a memorandum submitted by the Contractor to the Architect for approval by the Owner.
 1. Facility/System Date Starting Time Duration
- E. Emergency disruptions: When circumstances preclude obtaining advance approval as specified above; make request immediately on knowledge of the requirement, and perform

work so as to cause the minimum amount of disruption, for the minimum duration.

- F. Notification: Notify the Architect and the Owner immediately by telephone and then in writing, as changes and additions to the scheduled disruption requirements become known.
- G. Duration: Complete as large a portion of the work as possible before initiating disruption and perform only that work necessary so as to minimize duration of disruption. Maintain adequate personnel, supplies, materials, equipment, tools, and other resources at job site to avoid unnecessary delay in resumption of normal service.

3.02 GENERAL

- A. The Drawings and specifications are intended to accomplish certain objectives. These documents do not purport to indicate methods the Contractor is to use in accomplishing the objectives. They show conduit and wire sizes and they describe the various systems. These documents describe and size equipment, its general location, usage, support and auxiliary requirements. They also describe most, but not all, of the materials and their usage for this project.
- B. Contract Documents do not, however, detail certain job requirements. In most instances they do not show exact layouts, locations or elevations of any fixtures, conduits, anchors, sleeves, hangers, slots, holes, outlets, inserts, elbows, or fittings. They do not show final precise location of equipment by dimension in most instances, or manufacturer's requirements for proper installation, operation and maintenance or manufacturer's requirements for proper installation, operation, and maintenance.
- C. In general, conduit in finished areas of the building shall be run concealed in chases, walls, floor slabs, furrings, and above suspended ceilings, unless noted or indicated otherwise. Should any condition arise which would cause any conduit to be exposed in finished area, it shall be immediately called to the Architect's attention and correction of the condition shall be made in accordance with the Architect's instruction. Runs of conduit shall be grouped wherever it is feasible to do so. Conduits shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing.
 - 1. In unfinished spaces such as equipment rooms, conduit shall be installed parallel to the building plates, shall be run as high as possible, and shall be square to the building and securely supported. A high quality of workmanship is expected.
 - 2. Conduits shall not be run above grade, outside, exposed on any external walls, or across the roof exposed, without the express written permission of the Architect.
 - 3. Conduit openings shall be capped during construction until the systems are closed with final connections.
- D. The exact location of each item shall be determined by reference to the project Contract Drawings, and to details, equipment drawings, roughing-in drawings, by measurement at the building, and in cooperation with the various trades. In congested spaces (such as below raised floors), Contractor shall develop a special hierarchy to coordinate electrical with other trades. Contact Architect for additional guidance. Minor relocations necessitated by the conditions at the site or directed by the Owner shall be made without additional cost to the Owner.
- E. Coordinate proper locations and sizes of slots, holes or openings in the building structure pertaining to this work, and for the correct location of sleeves. Place inserts to accommodate the ultimate installation of hangers in the forms, and set sleeves in forms before concrete is poured, and in masonry walls while they are under construction. Concealed lines shall be installed as required by the pace of the job to precede the general construction.
- F. Except for items that are furnished with factory installed integral motors, an electric motor of required size and electrical characteristics will be provided under Division 22 and 23 for each item of motor-driven equipment as specified in Sections 22500 and 230500. Complete the electrical installation of these motors in accordance with approved wiring diagrams and instructions. Motor feeders and branch circuits conductors shall be copper throughout.

- G. Provide the setting and electrical connections for each item of control equipment. Connections shall be made in accordance with approved wiring diagrams and instructions.
- H. Provide the correct size heater elements or solid-state overload device settings to protect each motor and allow it to operate based on motor load (full load current) of the actual motor installed in each instance, and ambient temperature experienced on each individual motor.
- I. Provide electrical connections to each item of equipment requiring such connections.
- J. Final connection shall be made with at least two feet (no more than six feet) of liquid-tight flexible conduit.
- K. Where possible, terminate conduits in conduit boxes on motors. Where motors are not provided with conduit boxes, terminate the conduits in conduit fittings at motors.
- L. Where disconnect switches are not provided integral with the control equipment for motors, provide disconnect switches required by these Specifications (Refer to Division 22 and 23) and the NEC. Generally, disconnect switches shall be heavy-duty, enclosed, externally operable, horsepower rated switches with voidable cover interlocks of adequate capacity for the duty intended. Each disconnect switch shall be installed as close as possible to the motor or controller it serves (and in no case farther than 50 feet (1524 cm) from the motor or controller served), and shall be within sight of the motor or controller served. Use horsepower rated toggle switches for small fractional horsepower motors. Use weatherproof enclosures outdoors and at cooling towers.

3.03 SALVAGE, DEMOLITION AND RELOCATION

- A. General:
 - 1. Modify, remove, or relocate materials and items indicated on the Drawings or required by the installation of new facilities.
 - 2. Remove demolition material from the site and deliver salvage materials to destinations on the premises, as directed.
- B. Relocations:
 - 1. Repair and restore to good functional condition, equipment, materials and items scheduled for relocation, which are damaged during dismantling or reassembly operations.
 - 2. Remove carefully, in reverse order to original assembly or placement, items which are to be relocated.
 - 3. Protect items until relocation is complete.
 - 4. Clean and repair items to be relocated, and provide new materials, fittings, and appurtenances required to complete the relocations and to restore to good operating order.
 - 5. Perform the relocation work in accordance with applicable Sections of these Specifications, utilizing skilled workers.
- C. Relocating Devices: Remove and reinstall in locations designated by the Architect temperature control system devices, relays, wire, conduit, fixtures, equipment and other devices required for the operation of the various systems that are installed in existing-to-be-removed construction.

3.04 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

- E. Right of Way: Give to piping systems installed at a required slope.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50.8 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe 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.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.08 TOUCH UP PAINT

- A. Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.
- C. Non-equipment Surfaces: Match type and color undamaged, existing adjacent finish.

3.09 EDGE GUARD

- A. Provide protective trim for exposed and unfinished edges of metal where conductors are subject to damage, to include, but not limited to, the following:
 - 1. Panelboards
 - 2. Junction boxes
 - 3. Switchgear
 - 4. Disconnect switches
 - 5. Control cabinets
 - 6. Mechanical unit
 - 7. Starters
- B. Protective trim shall be:
 - 1. Vinyl covered.
 - 2. Bonded to extruded PVC.
 - 3. Flexible, segmented metal core surrounded by 0.018" thick cold rolled steel.
 - 4. Smooth finish.
 - 5. Heat resistance of 150 degrees Fahrenheit (65.56 degrees Celsius) for continuous use.
 - 6. Self-extinguishing.
 - 7. Equal to Protective Trim products available from McMaster-Carr under "Protective Bumpers and Trim" section.

3.10 CONSTRUCTION REQUIREMENTS

- A. The Drawings and Specifications are intended to accomplish certain objectives. These documents do not purport to indicate methods the Contractor is to use in accomplishing the objectives. They show conduit and wire sizes and they describe the various systems. These documents describe and size equipment, its general location, usage, support and auxiliary requirements. They also describe most, but not all, of the materials and their usage for this project.
- B. Contract Documents do not, however, detail certain job requirements. In most instances, they do not show exact layouts, locations or elevations of any fixtures, conduits, anchors, sleeves, hangers, slots, holes, outlets, inserts, elbows, or fittings. They do not show final precise location of equipment by dimension in most instances.
- C. In general, conduit in finished areas of the building shall be run concealed in chases, walls, floor slabs, furrings, and above suspended ceilings, unless noted or indicated otherwise. Should any condition arise which would cause any conduit to be exposed in finished area, it shall be immediately called to the Architect's attention and correction of the condition shall be made in accordance with the Architect's instruction. Runs of conduit shall be grouped wherever it is feasible to do so. Conduits shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing.
 - 1. In unfinished spaces such as equipment rooms, conduit shall be installed parallel to the building plates, shall be run as high as possible, and shall be square to the building and securely supported. A high quality of workmanship is expected.
 - 2. Conduits shall not be run above grade, outside, exposed on any external walls, or across the roof exposed, without the express written permission of the Architect.
 - 3. Conduit openings shall be capped during construction until the systems are closed with final connections.
- D. The exact location of each item shall be determined by reference to the project Contract Drawings, and to details, equipment drawings, roughing-in drawings, by measurement at the building, and in cooperation with the various trades. In congested spaces (such as below raised floors), Contractor shall develop a special hierarchy to coordinate electrical with other trades. Contact Architect for additional guidance. Minor relocations necessitated by the conditions at the site or directed by the Owner shall be made without additional cost to the Owner.

- E. Coordinate proper locations and sizes of slots, holes or openings in the building structure pertaining to this work, and for the correct location of sleeves. Place inserts to accommodate the ultimate installation of hangers in the forms, and set sleeves in forms before concrete is poured, and in masonry walls while they are under construction. Concealed lines shall be installed as required by the pace of the job to precede the general construction.

3.11 EQUIPMENT FOUNDATIONS, HANGERS AND SUPPORTS

- A. For floor-mounted electrical equipment, provide concrete house-keeping pads not less than 3-1/2 inches (89 mm) thick, reinforced with No. 3 dowels and No. 3 bars 2'-0" on center each way. Pour housekeeping pads in forms built of new-dressed 2-inch by 4-inch framing lumber, extending 4 inches (101.6 mm) on all sides beyond the limits of the installed equipment. Chamfer all corner edges of the pads all around by means of sheet metal or triangular wood strips nailed to the forms. Place foundation bolts in the forms before concrete is poured, after locating them correctly from templates. Allow 1-inch below equipment bases for alignment and of the building where indicated. Construct foundations in accordance with approved shop drawings. Set equipment in place on concrete pads; level and align by means of shims prior to making service line connections, and apply grout. Use 3000 psi (20684.28 kPa), 28-day compressive strength concrete.
- B. Suspended equipment shall have supports consisting of manufactured metal framing or hangers conforming to Section 260529. Also provide engineered vibration isolators for suspended transformers.
- C. Structural steel stands for support of equipment that is not floor mounted or suspended from overhead structure shall be constructed the same as specified in heavy duty pipe racks in Section 260529.
- D. Where applicable, concrete foundation pads for outdoor switchgear and transformers shall conform to electrical utility specifications.

3.12 ELECTRICAL WIRING OF MOTORS, ALTERNATORS, AND EQUIPMENT

- A. Except as otherwise specified in Division 21, 22, and 23, field wiring of motors and equipment shall be provided under Division 26.
- B. See Divisions 21, 22 and 23 Sections for detailed requirements.
- C. Conductor terminations to leads shall be properly insulated. Pre-engineered kits shall be used for large apparatus.

3.13 EQUIPMENT CONNECTIONS

- A. Provide equipment furnished under Divisions 21, 22 and 23 and Divisions 26, 27, and 28, and Civil Engineering documents with necessary power, control, and communication wiring utility connections completed to allow safe and proper operation of the equipment.
- B. Provide similar complete utility connections for equipment furnished under Divisions 1 through 20, inclusive, by the Owner, or under other contracts, using materials of similar quality to those used in making connections to similar Divisions 21, 22, 23, 26, 27 and 28 equipment with similar finishes.
- C. Apply in writing to the Architect for any information needed to complete this work.

END OF SECTION

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. This Section includes the following:
 1. Building wires and cables rated 600 V and less.
 2. Connectors, splices, and terminations rated 600 V and less.
 3. Sleeves and sleeve seals for cables.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.06 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

1.07 SPECIAL WARRANTY

- A. Heating Cable: Manufacturer agrees to repair or replace electric heating cable that fails within ten (10) years from date of substantial completion.

PART 2 PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN or XHHW.
- C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.02 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- B. Connectors: Make splices and connections in conductors using UL listed solderless pressure connectors. For all connections up to a maximum of one (1) No. 6 with two (2) No. 8 conductors, use Ideal "Wingnuts" of required sizes. Connections in conductors or combination of conductors larger than described above shall be made using Burndy cable fittings of the type and size required for the specific duty. After splice is securely "made-up", entire assembly shall be insulated with UL listed insulating tape to a value equivalent to the adjacent insulation. Ground connections shall be made using Burndy ground clamps or connectors of a type suitable and UL listed for duty involved.

2.03 PLASTIC-INSULATED, SERIES-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Delta-Therm Corporation.
 2. Easy Heat Inc.
 3. NUHEAT.
 4. Orbit Manufacturing.
 5. Pyrotenax; a division of Tyco Thermal Controls.
 6. Raychem; a division of Tyco Thermal Controls.
 7. WarmlyYours.com Inc.
 8. Watts Radiant Inc.
 - a. Comply with IEEE 515.1.
 - b. Heating Element: Single- or dual-stranded resistor wire. Terminate with waterproof, factory-assembled nonheating leads with connectors at both ends.
 - c. Electrical Insulating Jacket: Minimum 4.0-mil (0.10-mm) Kapton with silicone jacket or Tefzel.
 - d. Capacities and Characteristics:
 9. Maximum Heat Output: 6 W/ft. (19.7 W/m).
 10. Piping Diameter: Refer to Specification Divisions 22 and 23.
 11. Number of Parallel Cables: 2
 12. Spiral Wrap Pitch: 3 inches (76.2 mm).
 13. Verify available voltages and heat-output ratings with specified manufacturer.
 14. Volts: 120 V.
 15. Phase: 1 PH.
 16. Hertz: 60 Hz
 17. Full-Load Amperes: 24
 18. Minimum Circuit Ampacity: 30 A
 19. Maximum Overcurrent Protection: 30 A
 - a. Remote bulb unit with adjustable temperature range from 30 to 50 deg F (minus 1 to plus 10 deg C).
 - b. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
 - c. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
 - d. Corrosion-resistant, waterproof control enclosure.
 - e. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
 - f. Warning Labels: Refer to Division 23 Section "Identification for HVAC Piping and Equipment."
 - g. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 20. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (5.91 inch (150 mm)): 3/4 inch (19.05 mm) minimum.
 21. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (5.91 inch (150 mm)) or Larger: 1-1/2 inches (38 mm) minimum.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.03 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 and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (152.4 mm) of slack.

3.04 INSTALLATION

- A. Feeder and branch circuit conductors rated at 600 volt and below shall be sized to prevent voltage drop values exceeding the limits set forth in the NEC.
- B. Care shall be exercised in handling and installing cables to avoid damage. Cables shall be carefully formed in equipment pull boxes and manholes. Bends in cables shall be larger than the minimum radii shown in the cable manufacturer's published data for minimum bends that will not reduce the cable life.
- C. MC cable is only allowed within partitions and millwork where approved by owner in writing. Where used, MC cable must be properly supported per NEC requirements.

3.05 HEAT TRACE CABLES

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.
- C. Install electric heating cables after piping has been tested and before insulation is installed.
- D. Install electric heating cables according to IEEE 515.1.
- E. Install insulation over piping with electric cables according to Division 23 Section "HVAC Insulation."
- F. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- G. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Protect installed heating cables, including nonheating leads, from damage.

3.06 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.07 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services 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.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. 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.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

END OF SECTION

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SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
 1. Underground distribution grounding.
 2. Common ground bonding with lightning protection system.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 PRODUCTS

2.01 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-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 (6.35 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 (1.59 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 (1.59 mm) thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 inch by 4 inches (6 by 100 mm) in cross section, unless otherwise indicated on Drawings; with insulators.

2.02 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.03 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel (or stainless steel in highly corrosive soil); 5/8 inch (15.88 mm) by 10 feet (304.8 cm) in length.

- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1219.2 mm) long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 EXECUTION

3.01 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 barecopper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (609.6 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (304.8 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch (25.4 mm), minimum, from wall 6 inches (152.4 mm) above finished floor, unless otherwise indicated.
- 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.

3.02 GROUNDING OVERHEAD LINES

- A. Comply with IEEE C2 grounding requirements.
- B. Install 3 parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.
- C. Drive ground rods until tops are 12 inches (304.8 mm) below finished grade in undisturbed earth.
- D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.
- E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.
- F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.
- G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.03 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (101.6 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50.8 mm) above to 6

inches (152.4 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: For all Owner furnished equipment or where required by the utility company. Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (152.4 mm) from the foundation.

3.04 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. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 - 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray 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 Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- 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. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in

raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.05 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. Common Ground Bonding 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 (50.8 mm) below finished floor or final grade, unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (304.8 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 so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. 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 (1828.8 cm) apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of area or item indicated.
 - 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 (609.6 mm) from building foundation.
- J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (609.6 cm) of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet (609.6 cm) long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.
- K. Communications Grounding:
 - 1. Telephone: Provide one No. 2 "THW" to ground bus at each telephone equipment room; one No. 2 "THW" to telephone service conduits; and, one No.12 "THW" to conduits terminating at telephone backboards.
 - 2. Communications and Special Systems: Provide one No. 6 "THW" in 1/2-inch conduit from each system ground to nearest ground bus.
 - 3. Fire Alarm Systems: Provide one No.6 "THW" in 1/2-inch conduit from each system ground to nearest ground bus.
 - 4. Television Distribution Systems: Provide one No. 6 "THW" in 1/2-inch conduit from each system ground to nearest ground bus.

3.06 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less 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.
 - 3. 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.
- B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 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. Manhole Grounds: 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

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**SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. MFMA-4 - Metal Framing Standards Publication; 2004.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration Controls For Electrical Systems" for products and installation requirements necessary for compliance.

1.04 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.05 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.06 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.

1.07 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.08 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 4. 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 (203.2 mm) o.c., in at least 1 surface.
 - 1. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 2. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 - 3. 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 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. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used. Not approved for light weight concrete or slabs less than six (6) inches thick.
 - 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.
 - 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. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.02 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 Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 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 scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6.35 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 two-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: Conduits or raceways may not be supported by openings through structure members.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (101.6 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (101.6 mm) thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "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.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (101.6 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "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.

3.05 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 inch (0.05 mm)).
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

**SECTION 26 0533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

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. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.04 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. IMC: ANSI C80.6.
- C. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1.02 mm), minimum.
- D. EMT: ANSI C80.3.
- E. FMC: Zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel, compression type.

3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1.02 mm), with overlapping sleeves protecting threaded joints.
 4. Fittings for RMC and IMC: Steel, threaded.
- H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.02 NONMETALLIC CONDUIT AND TUBING

- A. ENT: NEMA TC 13.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. LFNC: UL 1660.
- D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material. Provide watertight joints on all underground installations.
- E. Fittings for LFNC: UL 514B.

2.03 METAL WIREWAYS

- A. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Hinged type unless noted otherwise on the drawings.
- D. Finish: Manufacturer's standard enamel finish.

2.04 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.

2.05 BOXES, ENCLOSURES, AND CABINETS

- A. Junction and pull boxes 100 cubic inches in volume and smaller shall be standard outlet boxes. Those larger than 100 cubic inches shall be constructed as specified for cabinet construction and shall be furnished with covers. Boxes shall be factory-fabricated from galvanized steel to prevent corrosion.
- B. Size boxes in accordance with the requirements of the NEC. Boxes not used for service entrance duty shall be no smaller than 4 inches (101.6 mm) square and 1-1/2 inches (38 mm) deep with covers accessible at all times. Set boxes on concealed conduits with covers flush with the finished wall or ceiling line. Provide junction and pull boxes of appropriate dimensions for conduits and conductors noted, where shown and where necessary for the installation and pulling of cables and wires. Install covers on junction boxes and condulets after wiring and connections are completed.
- C. At each outlet shown provide a box of suitable size and construction. Provide plaster rings, where required, in connection with adjacent plaster finishes. In unfinished masonry walls provide handy boxes of such size as to permit their being completely covered by the device plates. All boxes shall be galvanized steel. Unused knockouts in boxes shall be filled or capped before plates or devices are installed.
- D. Ceiling outlets shall be 4-inch square boxes of the appropriate depth, furnished with 3/8-inch fixture studs fastened through from backs of the boxes. For plaster surfaces provide plaster rings and ears.
- E. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Provide steel box mounting bracket for mounting to wood or steel studs per UNT Design Guide Appendix 32, Fig 32.

- F. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- G. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- H. Nonmetallic Floor Boxes: Nonadjustable, round.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- K. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
- L. 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.

2.06 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, as indicated for each service.
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two. Not approved for areas subject to vehicle traffic.
- C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame. Not approved for areas subject to vehicle traffic.
- D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete or fiberglass.

2.07 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.08 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.09 FLOOR, CEILING AND WALL PLATES

- A. In finished areas having ceilings, provide chrome plated, sectional escutcheons on exposed conduits and hanger rods penetrating walls, floors and ceilings.
- B. Size escutcheons to fit snugly around conduits and rods and cover completely the openings through which the conduits and rods pass. Hold escutcheons firmly in place with set screws or clamps.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit RNC, Type EPC-80-PVC.
 2. Concealed Conduit, Aboveground: Rigid steel conduit RNC, Type EPC-40-PVC.
 3. Underground Conduit: RNC, Type EPC- 40-PVC, direct buried.
 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.
 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete or fiberglass-reinforced polyester resin, SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: PVC-coated rigid steel conduit.
 7. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) 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.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

- 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.

3.02 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (152.4 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. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- I. 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.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. 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 36 inches (914.4 mm) of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install metallic raceways as follows:
 - 1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (1524 cm).
 - 2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (2286 cm).
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations 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 at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- N. Flexible Conduit Connections: Use maximum of 72 inches (1828.8 mm) of flexible conduit for 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.

- O. 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.
- P. Set metal floor boxes level and flush with finished floor surface.
- Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- R. For systems over 600 volts:
 - 1. Raceways for cable, provided under this Section, carrying more than 600 volts shall be standard, hot-dipped, rigid, galvanized, conduit. Raceways run underground other than under buildings or roadways, shall be non-metallic conduits encased in concrete.
 - 2. Couplings, for non-metallic conduits, that are compatible with the raceway, shall be recommended and installed in accordance with manufacturer's instructions. Field cuts of non-metallic conduit shall be made with tools specifically recommended by and in accordance with the instructions of the raceway manufacturer.
 - 3. Raceways run underground shall be run straight, with a minimum number of changes in direction. No changes in direction will be permitted due to improper ditching or support. Changes in direction shall be made only where indicated on the Drawings, and where specific approval is given. Offsets and bends up to 22.5 degrees may be made with non-metallic raceways. Bends greater than 22.5 degrees shall be made only with rigid steel conduit, and with each bend having a radius 12 feet (365.76 cm) or more. The total changes in direction in a single run (between manholes and pull boxes) shall not exceed 90 degrees. Bell ends shall be provided at conduit terminals in manholes, handholes and concrete pull boxes.
 - 4. Connections from non-metallic conduit to rigid galvanized steel conduit shall be made with screw-on adapters.
 - 5. Factory plugs shall be used to close all raceway ends immediately after the raceway installation. Suitable factory caps shall be installed on ends of runs during the construction period. Raceways with conductors shall be closed with sealing compound immediately after the conductors are in place.
 - 6. Non-metallic conduit shall be held in place during placement with plastic base spacers, plastic intermediate spacers, and ties located not more than 5 feet (152.4 cm) apart to maintain raceway separation. Unless otherwise indicated, underground raceways under concrete paved areas shall be direct buried; in non-paved areas shall be separated by 2 inches (50.8 mm) of concrete and covered by not less than 3 inches (76.2 mm) of concrete on bottom, top and sides. The concrete encasement (non-reinforced) shall be on top of 3-inch sand fill placed in trench before raceways are installed. Banks of underground raceways shall be installed by the built-up method. Raceways shall be securely anchored together and held in place to avoid misalignment and floating during pouring of the concrete encasement.
 - 7. Wherever underground raceways pass under buildings and roadways and for a distance of 5 feet (152.4 cm) from each building, and elsewhere as indicated, standard rigid galvanized steel conduit shall be used. This steel conduit shall also be concrete-encased and shall have insulating bushings wherever terminated.
 - 8. Each conduit shall have a test mandrel of a diameter 1/4-inch less than, and a minimum length equal to, the nominal diameter of the conduit pulled through. This shall be rodded, if necessary. Immediately before the cable is pulled in each conduit, a wire brush and swab shall be pulled through the conduit. Immediately after a cable is pulled in, plug the conduit run ends with duct seal, or approved equal. Contractor shall install this "seal" on both power and communication cables, whether cable is installed by him or by others.
 - 9. Concrete Encasement:
 - a. Provide red-dyed concrete encasement affording not less than 3 inches (76.2 mm) cover for raceways containing conductors having a voltage of more than 600 volts.
 - b. Concrete used for encasement of raceways shall be not less than 2500 pounds test at 28 days, and the maximum aggregate size shall not exceed 3/4-inch in diameter.
 - c. Concrete encasement shall have a homogeneous red color, obtained as follows: Mix water, sand, gravel and Portland Cement same as for foundation concrete; then two

- (2) minutes before pouring, add not less than five (5) pounds of L. Sonneborn Sons, Inc., "Sonobrite Red" for each bag of Portland Cement in mixture, and continue mixing until thoroughly blended.
- d. Concrete encasement shall be poured and tamped carefully to prevent voids between, under, beside or on top of the ducts.
 - e. Concrete encasement around "steel reinforced ductbanks" shall contain steel bars. Reinforcing bars shall be of the grade, type, and quality set forth for concrete walls in Division 3 of these Specifications. Unless indicated on the Drawings, each bank of ducts shall have one No. 4 bar in each of the four (4) corners of the bank with vertical and horizontal supports these bars consisting of No. 3 bars not more than 30-inches on centers along the duct bank run. Bars shall be located in the center of the 3-inch concrete cover for the raceways.
 - f. The concrete encasement for the ductbank shall be dowelled into walls and grade beams where entering or passing through buildings. Dowels shall consist of No. 6 bars located not more than 8 inches (203.2 mm) on centers around the perimeter of the ductbank, and shall tie to both the wall and the ductbank steel.
- S. For systems 600 volts and below:
- 1. Underground conduits and conduits buried under concrete slabs on the ground shall be PVC conduit, or shall be rigid steel conduit having a protective wrapping. All stubups of PVC conduit runs shall be made with rigid galvanized steel conduit. (Provide corrosion protection where the conduit emerges from the concrete, from 3-inches below top of concrete to 3-inches above.)
 - 2. Metal conduits encased in concrete shall be galvanized rigid steel.
 - 3. Conduits exposed to the weather, and conduits above the roof of the building shall be galvanized rigid steel, having a corrosion-protective coating as specified above.
 - 4. Conduits shall be exposed in mechanical equipment rooms. Where exposed conduits are located at or within five feet (5') of the floor, they shall be galvanized rigid steel conduit or IMC. Other conduits on this project may be rigid, IMC, or EMT as permitted by code.
 - 5. Conduits shall be of such size and so installed that the conductors may be drawn through without injury or excessive strain, shall be secured at cabinets and boxes of all types, with galvanized locknuts, both inside and outside, and shall have appropriate bushings inside. Bushings may be of the insulating type or may be galvanized, unless bushings are used for grounding, in which case they shall be galvanized.
 - 6. Threaded conduits shall be reamed after threading, and shall be kept tightly closed at each end and in dry locations during construction. Conduits shall be swabbed out before the wires are pulled through.
 - 7. Conduit which is larger than 1 inch (25.4 mm) shall not be run horizontally within any floor slab, and where floor slab construction is no more than 2-1/2 inches (64 mm) thick no conduits shall be run horizontally within such concrete construction. Should it become necessary for a large number of conduits to be stubbed up at one location (for instance at a telephone terminal board or at a panelboard) such conduits shall be separated by at least 12 inches (304.8 mm) if run within the floor slab, and if this is not possible, conduits shall be extended into the attic space and then stubbed into the terminal location.
 - 8. Conduits piercing roofs shall be placed in position in time to be flashed.
 - 9. Final connections to motors shall be made with 12-inch or longer sections of flexible metal conduit. Flexible metal conduits shall also be employed to effect final connections to recessed lighting fixtures. Flexible metal conduits in damp locations and in mechanical equipment rooms shall be neoprene-jacketed, UL listed watertight, complete with WP connections.
 - 10. Metallic conduits shall be grounded in accordance with the requirements of the NEC.
 - 11. Conduits shall not be installed within 3 inches (76.2 mm) of hot pipes except where crossings are unavoidable, in which case a clearance of 1 inch (25.4 mm) is permissible.
 - 12. Provide junction, pull and splice boxes in conduit runs as required by the NEC and elsewhere as required to accommodate installation.

13. All conduits shall have a separate grounding conductor installed in accordance with NEC requirements.
 14. Where overhead junction boxes are provided for future extension of wiring or to accommodate tenant needs, identify such boxes as "120-volt workstation clean", "277-volt normal", or "277-volt emergency", etc. with circuit numbers, to facilitate identification and future extensions from the boxes.
 15. Provide expansion couplings for all runs crossing building expansion joints. Provide expansion couplings for PVC conduit exposed and subject to temperature variations per Code.
 16. Provide flexible liquidtight metallic conduit between all underground conduits stubbed up through slabs and terminations interior to building.
- T. PVC telecommunications raceways underground shall be planned and installed with extreme care, especially under the building pad area. Contractor shall prepare large scale plan and profile drawings and pre-determine all bend lengths/radii prior to performing work.
- U. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (152.4 mm) in nominal diameter.
 2. Install backfill as specified in Division 31 Section "Earth Moving."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. Backfill shall consist of kiln dried grout sand from three inches below bottom surface of lowest conduit in duct bank to three inches above top surface of highest conduit in duct bank. Sand shall be agitated with vibrator to insure void spaces around conduit are filled. Cement stabilized sand in a flowable fill mixture may be used as an alternative to kiln dried sand. After placing controlled backfill to within 12 inches (304.8 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (76.2 mm) of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1524 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
 5. Warning Planks: Bury warning planks approximately 12 inches (304.8 mm) above direct-buried conduits, placing them 24 inches (609.6 mm) o.c. Align planks along the width and along the centerline of conduit.
 6. Direct-bury conduits that are routed parallel to one another shall be supported with saddles and spacers to insure a minimum of 7.5 inches (190.5 mm) between conduit centerlines in any direction. For conduits larger than 4 inches (101.6 mm) in diameter, there shall be a minimum of 3 inches (76.2 mm) separation from outside wall to outside wall in any direction.
 7. Parallel direct-bury conduits shall be evenly spaced and shall maintain spacing through the entire length of the conduits.

3.03 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25.4 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.04 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (406.4 mm), thickness shall be 0.052 inch (1.32 mm).
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (406.4 mm), thickness shall be 0.138 inch (3.51 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50.8 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.05 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.

- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.06 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.07 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

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**SECTION 26 0543
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. This Section includes the following:
 - 1. Conduit, ducts, and duct accessories for concrete-encased duct banks.
 - 2. Manholes.

1.04 DEFINITION

- A. RNC: Rigid nonmetallic conduit.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for manholes.
 - 4. Warning tape.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Reinforcement details.
 - 3. Frame and cover design and manhole frame support rings.
 - 4. Ladder and step details.
 - 5. Grounding details.
 - 6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - 7. Joint details.
- C. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer.

1.06 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

1.08 PROJECT 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 Owner no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.09 COORDINATION

- A. Coordinate layout and installation of ducts and manholes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes, and as approved by Architect.

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.
- B. Furnish cable-support stanchions, arms, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 PRODUCTS

2.01 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.02 NONMETALLIC DUCT ACCESSORIES

- A. Duct Accessories:
 - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
 - 2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.03 PRECAST MANHOLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or engineer approved equivalent:
 - 1. Carder Concrete Products.
 - 2. Christy Concrete Products.
 - 3. Elmhurst-Chicago Stone Co.
 - 4. Oldcastle Precast Group.
 - 5. Riverton Concrete Products; a Division of Cretex Companies, Inc.
 - 6. Utility Concrete Products, LLC.
 - 7. Utility Vault Co.
 - 8. Wausau Tile, Inc.
- B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.
 - 1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (304.8 mm) vertically and horizontally to accommodate alignment variations.

- a. Windows shall be located no less than 6 inches (152.4 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
- a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.
- C. Concrete Knockout Panels: 1-1/2 to 2 inches (50.8 mm) thick, for future conduit entrance and sleeve for ground rod.
- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.04 UTILITY STRUCTURE ACCESSORIES

- A. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 36 inches (914.4 mm).
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 2. Cover Legend: Cast in. Selected to suit system.
 - a. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
 - b. Legend: "SIGNAL" for communications, data, and telephone duct systems.
 3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
 - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- B. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- C. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and 1-by-4-inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- D. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches (70 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- E. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- F. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
1. Stanchions: Nominal 36 inches (914.4 mm) high by 4 inches (101.6 mm) wide, with minimum of 9 holes for arm attachment.
 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches (76.2 mm) with 450-lb minimum capacity to 20 inches (508

mm) with 250-lb minimum capacity. Top of arm shall be nominally 4 inches (101.6 mm) wide, and arm shall have slots along full length for cable ties.

- G. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- H. Fixed Manhole Ladders: Arranged for attachment to wall and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from hot-dip galvanized steel.

2.05 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.

PART 3 EXECUTION

3.01 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

3.02 UNDERGROUND ENCLOSURE APPLICATION

- A. Manholes: Precast.
 - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
 - 2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.03 ABOVE GROUND CONDUIT

- A. Rigid steel, galvanized, complying with ANSI C80.1.
- B. Install voltage markers.

3.04 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.05 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1219.2 mm), both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (254 mm) o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet (304.8 cm) from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (304.8 cm) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psi hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf-test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet (609.6 cm) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (152.4 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 - 2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches (457.2 mm) into concrete on both sides of joint near corners of envelope.
 - 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
 - a. Concrete for communications ducts shall be gray.
 - b. Concrete for electrical ducts shall be red.
 - 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 - a. Stirrups shall be #4 bars.
 - b. Reinforcing shall be #3 bars.
 - 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 - 6. Minimum Space between Ducts: 3 inches (76.2 mm) between ducts and exterior envelope wall, 2 inches (50.8 mm) between ducts for like services, and 4 inches (101.6 mm) between power and signal ducts.
 - 7. Depth: Install top of duct bank at least 30 inches (762 mm) below finished grade.

8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (76.2 mm) of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1524 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
9. Warning Tape: Bury warning tape approximately 18 inches (457.2 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (76.2 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches (304.8 mm) apart, horizontally.

3.06 INSTALLATION OF CONCRETE MANHOLES

- A. Precast Concrete Manhole Installation:
 1. Comply with ASTM C 891, unless otherwise indicated.
 2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
 3. Unless otherwise indicated, subbase for placement of manhole to be stabilized with 12" cement stabilized sand to provide level solid bearing surface before installation of manhole.
- B. Elevations:
 1. Manhole Roof: Install with rooftop at least 33 inches (838.2 mm) below finished grade.
 2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25.4 mm) above finished grade.
- C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- D. Manhole Access: Circular opening in manhole roof; sized to match cover size.
 1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
 2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
- E. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.
- G. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
- H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50.8 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
- I. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.07 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.08 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 - 3. Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.09 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION

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SECTION 26 0548
VIBRATION CONTROLS FOR ELECTRICAL SYSTEMS

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. This Section includes the following:
 - 1. Isolation pads.
- B. Related Sections include the following:
 - 1. Division 26 Section "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.03 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
- B. Delegated-Design Submittal: For vibration isolation 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation required to select vibration isolators.
 - 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 - 3. Field-fabricated supports.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated in the specifications or a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Mason Industries.
 - 3. Vibration Eliminator Co., Inc.
 - 4. Kinetics Noise Control.
- B. Pads: Arrange in two 3/8" layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene
 - 2. Peabody Type NGDD, Mason Type WSW, or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- 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.

3.02 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application.
- B. Provide vibration isolation pads beneath all transformers, uninterruptible power supplies and indoor generator sets.

END OF SECTION

**SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.04 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.05 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- 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.

1.06 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.

PART 2 PRODUCTS

2.01 POWER RACEWAY AND 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 raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Color scheme to comply with ANSI A13.1 and IECC C2.

2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 1. Black letters on an orange field.
 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high letters on 20-inch (500-mm) centers.
- D. Self-Adhesive 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 adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50.8 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (304.8 mm) wide. Stop stripes at legends.
- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

2.02 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0 inch (0.08 mm)) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50.8 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.03 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.04 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.
- C. Type:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils (0 inch (0.1 mm)).
3. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
4. 3-Inch (75-mm) Tensile According to ASTM D 882: 30 lbf (133.4 N), and 2500 psi (17236.90 kPa).

2.05 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. 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)."

2.06 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive or punched for screw mounting, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (9.52 mm).
 1. Label all service disconnects.
 2. Labels shall include voltage, circuit fed by, and name of device.

PART 3 EXECUTION

3.01 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 that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. 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.
- G. 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 (406.4 mm) overall.

3.02 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (304.8 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:
 1. Floor surface directly above conduits running beneath and within 12 inches (304.8 mm) of a floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl or Snap-around labels. Install labels at 10-foot (3-m) maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, and Feeder: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.
- D. 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. Power.
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, 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
 - 5) Ground: Green
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral: White
 - 5) Ground: Gray/Green
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (152.4 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.
- F. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.
- G. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- H. Conductors to Be Extended in the Future: Attach marker tape 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. Limit use of underground-line warning tape to direct-buried cables.
 2. 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. Circuit labels for outlet boxes: All 208/277/480V circuits shall be identified at each junction box it passes through, on the inside of the junction box cover per UNT Design Guidelines. All 120V outlet covers shall be labeled with the panel and circuit breaker number it is fed from.
- N. Arc-Flash & Shock-Hazard Warning Labels
1. Install arc-flash and shock hazard-warning labels that comply with ANSI Z535.4 on switchgear, switchboards, transformers, motor control centers, panelboards, motor controllers, safety switches, industrial control panels, and other electrical equipment that is likely to require examination, adjustment, servicing, or maintenance while energized.
 2. Locate the marking to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.
 3. On renovation projects, install arc-flash warning labels on existing equipment where lock-out/tag-out will be required for the renovation work.
 4. Provide the information listed below on each label. Specify that arc-flash warning label information be produced by the electrical equipment manufacturer or supplier as a part of the final power system studies to be submitted by the Contractor in accordance with the electrical acceptance testing.
 - a. Arc-Flash Protection Boundary
 - b. Arc-flash incident energy calculated in accordance with IEEE Std 1584a™
 - c. Working distance calculated in accordance with IEEE Std 1584a™
 - d. NFPA 70E Hazard / Risk Category Number or the appropriate personal protective equipment (PPE) for operations with doors closed and covers on.
 - e. System phase-to-phase voltage
 - f. Condition(s) when a shock hazard exists (e.g. "With cover off")
 - g. Limited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 - h. Restricted Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 - i. Prohibited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 - j. Unique equipment designation or code (described under "Component Identification" below)
 - k. Class for insulating gloves based on system voltage (e.g., Class 00 up to 500V)
 - l. Voltage rating for insulated or insulating tools based on system voltage (e.g., 1000V)
 - m. Date that the hazard analysis was performed.
 - n. "Served from" circuit directory information including the serving equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
 - o. If applicable, the "serves" circuit directory information including the served equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.

5. An abbreviated warning label may be used where it has been determined that no dangerous arc-flash hazard exists in accordance with IEEE 1584a™, paragraph 9.3.2.
 6. Use a "DANGER" label where the calculated arc-flash incident energy exceeds 40 cal/cm.
- O. 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.
- P. 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.
- Q. 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 Equipment: Self-adhesive or drilled for screw mounting, 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 (50.8 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, 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. Substations.
 - h. Emergency system boxes and enclosures.
 - i. Motor-control centers.
 - j. Enclosed switches.
 - k. Enclosed circuit breakers.
 - l. Enclosed controllers.
 - m. Variable-speed controllers.
 - n. Push-button stations.
 - o. Power transfer equipment.
 - p. Contactors.
 - q. Remote-controlled switches, dimmer modules, and control devices.
 - r. Power-generating units.
 - s. Monitoring and control equipment.

3.03 DOCUMENTATION

- A. Provide a typewritten chart, framed under glass, to correlate identification, abbreviations, equipment numbers, color schemes, and similar information.

- B. Provide an overall 1-line power distribution drawing, multi-colored, of the entire electrical distribution system, framed under glass and mounted in each building's main electrical room where directed. Contact architect for color scheme.

END OF SECTION

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**SECTION 26 0573
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY**

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. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1.03 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report, stamped and signed by the professional engineer performing the study.

1.04 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 PRODUCTS

2.01 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 - 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. The fault current and overcurrent protection device coordination studies shall be performed and submitted together with shop drawings and other equipment submittals for electrical distribution

equipment provided as part of this contract.

- B. Shop drawings and submittals for electrical distribution equipment will not be reviewed unless the fault current and overcurrent protection device coordination studies are also included.

3.02 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Impedance of utility service entrance.
 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.03 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
1. Switchgear and switchboard bus.
 2. Medium-voltage controller.
 3. Motor-control center.
 4. Distribution panelboard.
 5. Branch circuit panelboard.

- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
 - 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
 - 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
- F. Equipment Evaluation Report:
 - 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 - 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 4. Show AIC rating conclusions for all equipment and devices.

3.04 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 - 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141, IEEE 241, and IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that

equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION

**SECTION 26 0923
LIGHTING CONTROL DEVICES**

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. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor photoelectric switches.
 - 3. Indoor occupancy sensors.
 - 4. Lighting contactors.
- B. Related Sections include the following:
 - 1. Division 26 Sections "Modular Dimming Controls" for architectural dimming system equipment.
 - 2. Division 26 Section "Network Lighting Controls" for low-voltage, manual and programmable lighting control systems.
 - 3. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.03 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.04 SUBMITTALS

- A. Product Data: For each type of product.
- B. Operation and Maintenance Data: For each type of lighting control device.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.06 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.01 TIME SWITCHES

- A. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: DPST.
 - 2. Contact Rating: 30-A inductive or resistive, 240-V ac, 20-A ballast load, 120/240-V ac.
 - 3. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
 - 4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
 - 5. Astronomic Time: All channels.
 - 6. Battery Backup: For schedules and time clock.

2.02 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Description: Solid state, with DPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.
 - 1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
 - 2. Time Delay: 30-second minimum, to prevent false operation.
 - 3. Lightning Arrester: Air-gap type.
 - 4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.03 INDOOR OCCUPANCY SENSORS

- A. Provide products by the following manufacturer:
 - 1. Acuity Brands – “Sensor Switch” WSD, WSD-SA, WSD-PDT-SA, WSD-2P, WV-16, WV-BR, CMRB-9, MP-20, MSP-20, CM-9, CMR-9, and CMR-PDT.
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
 - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 - 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 - 6. Bypass Switch: Override the on function in case of sensor failure.
 - 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
- C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
 - 1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
 - 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 3. Detection Coverage (Corridor): Detect occupancy within 90 feet (2743.2 cm) when mounted on a 10-foot- (3-m-) high ceiling.
- D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
 - 1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (304.8 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches (304.8 mm)/s (12.01 inch (305 mm)/s).
 - 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (2743.2 cm) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (426.72 cm).
- E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
 1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (304.8 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches (304.8 mm)/s (12.01 inch (305 mm)/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
- F. Refer to Section 262726 for integral wall-mounted sensor/switches.

2.04 LIGHTING CONTACTORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. GE Industrial Systems; Total Lighting Control.
 2. Square D; Schneider Electric.
- B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as scheduled, but at a minimum provide auxiliary contacts, HOA switch, and pilot lights. Control devices shall match the NEMA type specified for the enclosure.
- C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
 1. Monitoring: On-off status.
 2. Control: On-off operation.

2.05 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors properly sized to meet NEC requirements. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors properly sized to meet NEC requirements. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.02 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.03 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (12.7 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.04 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.05 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.
- C. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.06 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

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**SECTION 26 0943
NETWORK LIGHTING CONTROLS**

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. This Section includes manually operated, PC-based, digital lighting controls with relays and control module.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for time switches, photoelectric switches, occupancy sensors, and multipole contactors.
 - 2. Division 26 Section "Modular Dimming Controls" for dimming control components.

1.03 DEFINITIONS

- A. BACnet: A networking communication protocol that complies with ASHRAE 135.
- B. BAS: Building automation system.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.
- E. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- F. PC: Personal computer; sometimes plural as "PCs."
- G. Power Line Carrier: Use of radio-frequency energy to transmit information over transmission lines whose primary purpose is the transmission of power.
- H. RS-485: A serial network protocol, similar to RS-232, complying with TIA/EIA-485-A.

1.04 SUBMITTALS

- A. Product Data: For control modules, power distribution components, manual switches and plates, and conductors and cables.
- B. Shop Drawings: Narrative sequence of operations, detail assemblies of standard components, custom assembled for specific application on this Project.
 - 1. Most important - Narrative Description: Written description outlining the summary of the sequence of operations for each space type.
 - a. Example: Room number XXX: This open dining area has 5 dimming zones of control. The all the zones automatically come ON each day to 85%, 1 hour before the dining hall opens and OFF 30 minutes after the dining hall closes. These settings can be manually overridden to OFF or to a different dimming setting via wall switches during the day. During the off-hours the lighting is manual ON via wall switches and automatic OFF via vacancy sensors after 20 minutes of no activity. The emergency lighting in the room is controlled with the normal lighting during normal operations.
 - 2. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements that meet the narrative description.
 - 3. Block Diagram: Show interconnections between components specified in this section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

4. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- D. Comply with protocol described in IEC 60929, Annex E, for DALI lighting control devices, wiring, and computer hardware and software.
- E. Comply with NFPA 70.

1.06 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
 1. Match components and interconnections for optimum performance of lighting control functions.
 2. Coordinate lighting controls with BAS. Design display graphics showing building areas controlled; include the status of lighting controls in each area.
 3. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.
- B. Coordinate lighting control components specified in this Section with components specified in Division 26 Section "Panelboards."

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Failure of software input/output to execute switching or dimming commands.
 - b. Failure of modular relays to operate under manual or software commands.
 - c. Damage of electronic components due to transient voltage surges.
 2. Warranty Period: Two years from date of Substantial Completion.
 3. Extended Warranty Period Failure Due to Transient Voltage Surges: Eight years.
 4. Extended Warranty Period for Electrically Held Relays: 10 years from date of Substantial Completion.

1.08 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. Electrically Held Relays: Equal to 10 percent of amount installed for each size indicated, but no fewer than 10 relays.

1.09 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revise licenses for use of the software.
 1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Acuity Brands

2.02 SYSTEM REQUIREMENTS

- A. System shall be a complete modular low-voltage switching platform for use as a networked system with an internal microprocessor based building management interface module. System shall accept building automation system input for ON/OFF scheduled control and ON/OFF manual control shall be provided via low voltage data line switches, low voltage momentary switches and photocontrol. During "occupied" hours, system shall accept ON input from building automation system but shall be capable of being overridden to the OFF state per zone by manual controls. During "unoccupied" hours, system shall accept OFF input from building automation system but shall be capable of being overridden to the ON state per zone by manual controls for a period of two hours (adjustable.) Five (5) minutes prior to the system override expiration, the lighting control system shall blink the zone of lights that have been overridden twice to notify occupant the override period is expiring.
- B. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.
- C. Performance Requirements: Manual switches, an internal timing and control unit, and external sensors or other control signal sources send a signal to a PC-based programmable-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits, or routes variable commands to one or more dimmers, for groups of lighting fixtures or other loads.

2.03 CONTROL MODULE

- A. Control Module Description: Comply with UL 508 (CSA C22.2, No. 14); microprocessor-based, programmable, control unit; mounted in preassembled, modular relay panel. Low-voltage-controlled, latching-type, single-pole lighting circuit relays shall be prime output circuit devices. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays. Control units shall be capable of receiving inputs from sensors and other sources. Line-voltage components and wiring shall be separated from low-voltage components and wiring by barriers. Control module shall be locally programmable.
- B. Automation - Network Clock:
 - 1. Network Clock can be used to schedule any of the 8 global channel groups in the relay panel network.
 - 2. Network shall include user-selectable intelligent scenarios to handle standard lighting control functions for each channel independently, including:
 - a. Schedule ON / Schedule OFF
 - b. Manual ON / Schedule OFF
 - c. Astronomical ON / Astronomical OFF (with user selectable offsets)
 - d. Astronomical ON / Schedule OFF (with user selectable offsets)
 - e. Manual ON / Multiple OFF Sweeps using Automatic Control Switch
 - 3. Network Clock shall automatically detect the presence of a dataline Photocontrol Module and alter the Astronomic scenarios to Dark, accepting actual light level readings for the following scenarios:
 - a. Dark ON / Dark OFF
 - b. Dark ON / Schedule OFF
 - 4. Each channel can be assigned a standard time delay from 1-240 minutes (4 hours). During Occupied hours, the time delays do not take effect. During Unoccupied hours, the time delays will ensure that overridden lights are automatically turned off.

5. Each channel can be assigned an automatic blinking of the lights before they are turned off to allow occupants the opportunity to enter an override without being put in the dark.
6. Network Clock shall include system diagnostic functions to identify devices anywhere on the network dataline.
7. Clear 8-line, 22-character per line display and a simple user interface.
8. Takes into account leap year, daylight savings time, and holidays.
9. Provides system diagnostics for all components connected to the system.
10. Allows the user to plug into each dataline switch, run diagnostics, and reprogram the switch to any relay or channel.
11. Retains memory and time for a minimum of 10 years.
12. The BMS Interface Module shall allow an external automation device to provide the signal that changes channel status from Occupied to Unoccupied (after-hours).
13. The BMS Interface Module shall include system diagnostic functions to identify devices anywhere on the network dataline.

2.04 POWER DISTRIBUTION COMPONENTS

- A. Modular Relay Panel: Comply with UL 508 (CSA C22.2, No. 14) and UL 916 (CSA C22.2, No. 205); factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.
 1. Cabinet: Steel with hinged, locking door.
 - a. Barriers separate low-voltage and line-voltage components.
 - b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.
 - c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
 2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.
 - a. Low-Voltage Leads: Plug connector to the connector strip in cabinet and pilot light power where indicated.
 - b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts.
 - c. Endurance: 50,000 cycles at rated capacity.
 3. Mounting: Provision for easy removal and installation in relay cabinet.channels: Eight channels for grouping relays shall be provided in each interior regardless of size, each with a terminal block for a separate dry contact input. Any number of relays in the panel can be assigned to each channel, with overlapping allowed. Channels shall be set up without hand held programmer or keypads. Systems that require programmers or keypads, or that change relay states during set up, are not acceptable.
 4. Power Supply: Two separate 40 VA transformers in one power supply assembly shall be provided. Systems requiring a separate pilot light transformer circuit will not be acceptable. Transformers include internal overcurrent protection with automatic reset and metal oxide varistor protection against power line spikes.
 5. Network Dataline
 - a. The intelligence in multiple panels shall be linked over a single dataline that uses the open Echelon/LonTalk® protocol for communications. The dataline shall not require any ancillary equipment to function properly.
 - b. The dataline, in addition to linking together multiple relay panels, shall be capable of providing a single communications bus to allow dataline switches to communicate with the panels.
 - c. Dataline shall be 18 AWG, 4 unshielded copper conductors (two independent twisted pairs) meeting Class 2P NEC code requirements and shall be routed in conduit. The dataline can be run in a loop, serial, or star configuration.
 - d. Maximum length for all dataline wire in the system is 1,500 feet (45720 cm) without repeaters.
 - e. Maximum number of dataline devices is 64 without a repeater.

2.05 MANUAL SWITCHES AND PLATES

- A. Push-Button Switches: Modular, momentary-contact, low-voltage type.
 - 1. Match color specified in Division 26 Section "Wiring Devices."
 - 2. Integral green LED pilot light to indicate when circuit is on.
 - 3. Internal white LED locator light to illuminate when circuit is off.
- B. Manual, Maintained Contact, Full- or Low-Voltage Switch: Comply with Division 26 Section "Wiring Devices."
- C. Wall-Box Dimmers: Comply with Division 26 Section "Wiring Devices."
- D. Wall Plates: Single and multigang plates as specified in Division 26 Section "Wiring Devices."
- E. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.06 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors of an AWG recommended by the manufacturer, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors of an AWG recommended by the manufacturer, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5e or 6, as recommended by the manufacturer, for horizontal copper cable and with Division 27 Section "Communications Horizontal Cabling."

PART 3 EXECUTION

3.01 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install wiring in raceways. Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (12.7 mm).
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- E. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.
- G. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.02 COORDINATION WITH DRAWINGS

- A. Refer to the project drawings for additional requirements related to network lighting controls.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and assist in field testing. Report results in writing. This must be completed prior to the engineer's final punch walk.

- B. Perform the following field tests and inspections and prepare test reports, prior to the engineer's final punch walk:
 - 1. Test for circuit continuity.
 - 2. Verify that the control module features are operational.
 - 3. Check operation of local override controls.
 - 4. Test system diagnostics by simulating improper operation of several components selected by Architect.
- C. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect or engineer as needed.

3.04 SOFTWARE INSTALLATION

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based control systems. Refer to Division 01 Section "Demonstration and Training." This must be done prior to the engineer's final punch walk.

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**SECTION 26 2200
LOW-VOLTAGE TRANSFORMERS**

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. This Section includes the following types of dry-type transformers rated 600 V and less:
 - 1. Distribution transformers.

1.03 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.06 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 2. General Electric (GE) products by ABB.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; Schneider Electric.

2.02 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Copper.

2.03 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: Gray.
- E. Taps for Transformers Smaller Than 3 kVA: None.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.
- K. Wall Brackets: Manufacturer's standard brackets.
- L. Sound levels shall be warranted by the manufacturer not to exceed the following:
 - 1. 15 – 50 kVA: 45 db
 - 2. 51 – 15- kVA: 50 db
 - 3. 151 – 300 kVA: 55 db

2.04 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.05 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Division 26 Section "Vibration Controls for Electrical Systems."

3.03 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Remove and replace units that do not pass tests or inspections and retest as specified above.
- C. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.
- E. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.05 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.06 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

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SECTION 26 2413 SWITCHBOARDS

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. Service and distribution switchboards rated 600 V and less.
 2. Disconnecting and overcurrent protective devices.
 3. Instrumentation.
 4. Control power.
 5. Accessory components and features.
 6. Identification.
 7. Mimic bus.

1.03 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 2. Detail enclosure types for types other than NEMA 250, Type 1.
 3. Detail bus configuration, current, and voltage ratings.
 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
 6. Include evidence of NRTL listing for series rating of installed devices.
 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Include selectable ranges for each type of overcurrent protective device.
 9. Include diagram and details of proposed mimic bus.
 10. Include schematic and wiring diagrams for power, signal, and control wiring.
 11. Equipment pad and foundations.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards 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 NEMA PB 2.

- F. Comply with NFPA 70.
- G. Comply with UL 891.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.
- C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.06 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (201168 cm).
- C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (201168 cm).
- D. 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 Architect 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 Architect's written permission.
 - 4. Comply with NFPA 70E.

1.07 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 2. Square D; a brand of Schneider Electric.
- B. Indoor Enclosures: Steel, NEMA 250, Type 1.

- C. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- D. Barriers: Between adjacent switchboard sections.
- E. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- F. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.
- G. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- H. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- I. Pull Box on Top of Switchboard:
 - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 - 2. Set back from front to clear circuit-breaker removal mechanism.
 - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 - 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- J. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, with tin-plated aluminum or copper feeder circuit-breaker line connections.
 - 2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 - 3. Ground Bus: Minimum-size required by UL 891, extending the entire length of switchboard, hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 - 6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- K. Future Devices: Equipment compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- L. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.
- M. Switchboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

- N. Refer to drawings and Sections 260913, 263533 and 264313 for related metering, power factor correction and surge protection devices, externally mounted from distribution equipment.

2.02 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. 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.
 2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I_{2t} response.
 3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, bolt-on type, trip ratings, and number of poles.
 - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - i. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- B. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
1. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
 2. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
 - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
 - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
 3. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
 4. Service-Rated Switches: Labeled for use as service equipment.

5. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
 - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
 - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
 - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
6. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- D. Fuses are specified in Division 26 Section "Fuses."

2.03 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
 1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
 3. Interface: Full interface with BMS system.
- C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.
 1. Meters: 4-inch (100-mm) diameter or 6 inches (152.4 mm) square, flush or semiflush, with antiparallax 250-degree scales and external zero adjustment.
 2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
- D. Instrument Switches: Rotary type with off position.

1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
 2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.
- E. Feeder Ammeters: 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.
- F. Watt-Hour Meters and Wattmeters:
1. Comply with ANSI C12.1.
 2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
 3. Suitable for connection to three- and four-wire circuits.
 4. Potential indicating lamps.
 5. Adjustments for light and full load, phase balance, and power factor.
 6. Four-dial clock register.
 7. Integral demand indicator.
 8. Contact devices to operate remote impulse-totalizing demand meter.
 9. Ratchets to prevent reverse rotation.
 10. Removable meter with drawout test plug.
 11. Semiflush mounted case with matching cover.
 12. Appropriate multiplier tag.
- G. Impulse-Totalizing Demand Meter:
1. Comply with ANSI C12.1.
 2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
 3. Cyclometer.
 4. Four-dial, totalizing kilowatt-hour register.
 5. Positive chart drive mechanism.
 6. Capillary pen holding a minimum of one month's ink supply.
 7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
 8. Capable of indicating and recording 15-minute integrated demand of totalized system.

2.04 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.05 IDENTIFICATION

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.
1. Nameplate: At least 0.032-inch- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.
- B. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

- C. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- D. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 COORDINATION WITH DRAWINGS

- A. Refer to project drawings for additional requirements and description of applicable accessories and sections.

3.03 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Comply with NECA 1.

3.04 CONNECTIONS

- A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
- B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.05 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems." Label service disconnecting means devices.
- D. Service Equipment Label: NRTL labeled for use as service equipment with one or more disconnecting and overcurrent protective devices.

3.06 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- E. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.07 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.08 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.09 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION

**SECTION 26 2416
PANELBOARDS**

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. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.03 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment
 - 1. Detail short-circuit current rating of panelboards and overcurrent protective devices.
 - 2. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include selectable ranges for each type of overcurrent protective device.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards 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 NEMA PB 1.
- F. Comply with NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not less than 23 deg F (minus 5 deg C) or more than plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (201168 cm).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (201168 cm).

- C. 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 Architect no fewer than seven days in advance of proposed interruption of electric service.
 2. Do not proceed with interruption of electric service without Architect's written permission.
 3. Comply with NFPA 70E.

1.07 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.08 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Wash-Down Areas: NEMA 250, Type 4X.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 7. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- C. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Compression type.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- D. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
- G. Refer to drawings and Sections 260913, 263533 and 264313 for related metering, power factor correction and surge protection devices, externally mounted from distribution equipment.

2.02 DISTRIBUTION PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 2. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches (914.4 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker lugs only, as scheduled on the Drawings.
- E. Branch Overcurrent Protective Devices for Circuit- Bolt-on circuit breakers
- F. Branch Overcurrent Protective Devices: Fused switches.
- G. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 2. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As scheduled on the Drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 2. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. 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.
 - 2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I₂t response.
 - 3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 4. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at percent of rated voltage.
 - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - h. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

- m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 - 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
 - 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
 - 3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch (27-GRC) empty conduits from flush mounted panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. After all equipment has been connected, measure loads of each bus. Then adjust branch circuit connections to balance load on each panel to maintain less than 15% difference between phases.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- J. Comply with NECA 1.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems." Label service disconnecting devices.
- E. Service Equipment Label: NRTL labeled for use as service equipment with one or more disconnecting and overcurrent protective devices.

3.04 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. 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.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- E. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.05 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.06 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

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**SECTION 26 2726
WIRING DEVICES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Receptacles with integral surge suppression units.
 - 4. Wall-box motion sensors.
 - 5. Isolated-ground receptacles.
 - 6. USB charger receptacles
 - 7. Snap switches and wall-box dimmers.
 - 8. Solid-state fan speed controls.
 - 9. Wall-switch.
 - 10. Pendant cord-connector devices.
 - 11. Cord and plug sets.
 - 12. Floor boxes, poke-through assemblies, service poles, and multioutlet assemblies.

1.04 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.07 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 2. Leviton Mfg. Company Inc. (Leviton).
 3. Legrand/Pass & Seymour; Wiring Devices & Accessories (Pass & Seymour).
 4. Arrow-Hart; Cooper Industries

2.02 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, WC596 and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL5351 (single), CR5352 (duplex).
 - b. Leviton; 5891 (single), 5352 (duplex).
 - c. Pass & Seymour; 5361 (single), CRB5362 (duplex).
 - d. Arrow-Hart; 5351 (single), 5362 (duplex)
- B. Plug load half-controlled receptacles, 125 V, 20A: Receptacle should be permanently marked with the universally recognized power symbol shown in NEC 2014 figure 406.3(E). Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, WC596 and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Leviton; 5352-1PW
 - b. Pass & Seymour; 5362CH
 - c. Hubbell BR20C1
- C. Plug load full-controlled receptacles, 125 V, 20A: Receptacle should be permanently marked with the universally recognized power symbol shown in NEC 2014 figure 406.3(E). Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, WC596 and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Leviton; 5352-2PW
 - b. Pass & Seymour; 5362CD
 - c. Hubbell BR20C2
- D. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, WC596 and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; CR 5253IG.
 - b. Leviton; 5362-IG.
 - c. Pass & Seymour; IG5362.
 - d. Arrow-Hart; IG5362RN
 2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- E. USB Charger Receptacles, 125V, 20A: Comply with NEMA WD6 configuration 5-20R, WC596 and UL498 and UL1310. Dual USB outlets required with a minimum of 3.1A, 5VDC.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; USB20X2W
 - b. Leviton; T5832
 - c. Pass & Seymour; TR5362USB
 - d. Arrow-Hart; TR7756
- F. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, WC596 and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL8300SG.
 - b. Leviton; MT5632
 - c. Pass & Seymour; TR5362.
 - d. Arrow-Hart; TR5362
2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.03 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, WC596, UL 498, and UL 943, Class A, and include indicator light that designates when device is tripped. Must have self-test feature (conducts and automatic test every three seconds) ensuring ground fault protection. If ground fault protection is compromised power to the receptacle must be discontinued.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A, WC596:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell GFRST20
 - b. Leviton GFNT2-W
 - c. Pass & Seymour; 2097.
 - d. Arrow-Hart; SGF20
- C. Blank Face GFCI devices, 125V, 20A: Faceless GFCI device intended to protect downstream receptacles; Leviton 7590, or equal.

2.04 TVSS RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6, WC596, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.
 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
 2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
- B. Duplex TVSS Convenience Receptacles:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL5362SA.
 - b. Leviton; 5380.
 - c. Pass & Seymour; 5362WSP
 - d. Arrow-Hart; 5350__S
 2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.
- C. Isolated-Ground, TVSS, Duplex Convenience Receptacles:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; IG5362SA.
 - b. Leviton; 5380-IG.
 - c. Pass & Seymour; IG5362WSP
 - d. Arrow-Hart; IG5350__S
 2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.05 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Hubbell; HBL2310.
 - b. Leviton; 2310.
 - c. Pass & Seymour; L520-R.
 - d. Arrow-Hart; CWL520R
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; IG2310.
 - b. Leviton; 2310-IG.
 - c. Pass & Seymour; IGL520R
 - d. Arrow-Hart; IGL520R
 2. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.06 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.07 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.08 SNAP SWITCHES

- A. Comply with NEMA WD 1, WC-896 and UL 20.
- B. Switches, 120/277 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1221 (single pole), HBL1222 (two pole), HBL1223 (three way), HBL1224 (four way).
 - b. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - c. Pass & Seymour; PS20AC1 (single pole), PS20AC2 (two pole), PS20AC3 (three way), PS20AC4 (four way).
 - d. Arrow-Hart; AH1221 (single pole), AH1222 (two pole), AH1223 (three way), AH1224 (four way)
- C. Pilot Light Switches, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1221PL for 120 V and 277 V.
 - b. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - c. Pass & Seymour; PS20AC1-RPL for 120 V, PS20AC1-RPL7 for 277V.
 - d. Arrow-Hart; AH1221PL for 120 V and 277 V
 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1221L.
 - b. Leviton; 1221-2L.
 - c. Pass & Seymour; PS20AC1-L.
 - d. Arrow-Hart; AH1221L
 2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1557.
 - b. Leviton; 1257.
 - c. Pass & Seymour; 1251.
 - d. Arrow-Hart; 1995B
- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.09 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 1. 600 W; dimmers shall require no derating when ganged with other devices.
- D. Fluorescent and LED Lamp Dimmer Switches: Modular; compatible with dimming ballasts or drivers; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
- E. Dimmers shall be Leviton "Monet", Lutron "Nova T-Star", or Pass & Seymour "Titan".

2.10 FAN SPEED CONTROLS

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 1. Continuously adjustable rotary knob, 5A.
 2. Three-speed adjustable rotary knob, 1.5 A.

2.11 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; WS1277.
 - b. Leviton; ODS 10-ID.
 - c. Pass & Seymour; WSP250.
 - d. Watt Stopper (The); WS301.
 - e. Arrow-Hart; 6119V
 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m)
 3. Provide single or dual level control as indicated on the drawings.

- B. Long-Range Wall-Switch Sensors:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100.
 - 3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).
- C. Wide-Range Wall-Switch Sensors:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.
 - b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100-3.
 - 3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

2.12 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic, except provide 0.035-inch- (1-mm-) thick, satin-finished stainless steel in all food servicing areas.
 - 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with metal in use lockable cover.

2.13 FLOOR BOXES

- A. Standard Floor Box: Floor box shall be two-gang with removable dividers. Each single-gang shall accommodate a duplex receptacle or two communication services. Unit shall be adjustable before and after pour. For on-grade application, floor box shall be cast iron. For above grade application, unit shall be stamped steel. Box shall have standard conduit tapping of $\frac{3}{4}$ " and a maximum conduit tapping of 1-1/4". Overplates shall be per Architect - Steel City 640/740 series or equal.
- B. Four (4) Device Combination Box: Floor Box shall have four independent wiring compartments. Each compartment shall be able to accommodate a duplex receptacle or four communication services. Unit shall be fully adjustable before and after pour. For above grade application, floor box shall be stamped steel. Activation compartment shall be flushed, recessed with carpet flange, hinged access plate, and retractable exit. Provide mounting brackets, plates, wiring, and devices as indicated on the Drawings. Walker RFB4 or approved equal.
- C. High Capacity Combination Floor Box: Floor box shall have minimum six (6) wiring compartments. Each compartment shall be able to accommodate a duplex receptacle or two communication services. Unit shall be fully adjustable before and after pour. For on-grade application, floor box shall be cast iron (stamped steel with vapor barrier is not acceptable). For above grade application, floor box shall be stamped steel. Activation compartment shall be flushed, recessed with carpet flange, hinged access plate and retractable exit. Provide mounting brackets, plates and wiring devices as indicated on the Drawings. Hubbell LCFB or equal.

1. Refer to drawings for detailed description of floor boxes and architectural/structural conditions.

2.14 POKE-THROUGH ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
 3. Wiremold Company (The).
- B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks.
 2. Size: Selected to fit nominal 3-inch (75-mm) cored holes in floor and matched to floor thickness.
 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 4. Closure Plug: Arranged to close unused 3-inch (75-mm) cored openings and reestablish fire rating of floor.
 5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, 4-pair, Category 5e voice and data communication cables.
 6. Standard poke-through device shall be Wiremold/Walker RC4 or equal.
 7. Standard poke-through furniture feed shall be Wiremold/Walker RC900-AM or equal.

2.15 MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Wiremold Company (The).
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish.
- D. Wire: No. 12 AWG.

2.16 SERVICE POLES

- A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
 1. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (152.4 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
 2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
 3. Finishes: Manufacturer's standard painted finish and trim combination.
 4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 3 or 5 voice and data communication cables.
 5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units.
 6. Voice and Data Communication Outlets: Blank insert with bushed cable opening.

2.17 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color. Provide wiring devices and wall plates in colors selected by the architect.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152.4 mm) in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 - 6. Modular devices are permitted for use. Modular connectors shall be UL listed and contain crimped and welded brass connections. Modular receptacles shall be listed to UL498 and WC-596G. Modular switches shall be listed to UL20 and WC-896.
 - 7. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 - 8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 9. Tighten unused terminal screws on the device.
 - 10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:

1. Install dimmers within terms of their listing.
 2. Verify that dimmers used for fan speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- J. Wall switches, unless noted otherwise, shall be mounted 48" above finished floor.
- K. Receptacles shall be mounted per A.D.A. height, above finished floor, except where heights are specifically called out on the Drawings. Receptacles above countertops in toilet rooms, dressing rooms, reception areas, and food service areas shall be mounted 6 inches (152.4 mm) above countertops or backsplashes, if not indicated otherwise on architectural details.
- L. Where signal, communications, data and control outlets are indicated adjacent to 115 volt or 230 volt convenience outlets, mount these outlets in a symmetrical pattern.
- M. If the outlets are normally mounted adjacent to each other throughout this project, they shall be mounted on 10 inch (254 mm) centers with the tops of the boxes at the same elevation. If one outlet is mounted adjacent to the floor, and the second outlet mounted adjacent to the ceiling, these outlets shall be lined up vertically whether so shown or not, in order to form a symmetrical pattern on the wall.
- N. Use blank face GFCI devices where the required location of receptacle will not allow proper access for testing and operation. Install blank face GFCI device to meet accessibility standards.

3.02 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot stamped or engraved machine writing with black lettering attached to inside of outlet box.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 2. Test Instruments: Use instruments that comply with UL 1436.
 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

END OF SECTION

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**SECTION 26 2813
FUSES**

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. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers and motor-control centers.
 - 2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches.
 - 3. Spare-fuse cabinets.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.05 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.07 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Bussmann, Inc.
 2. Edison Fuse, Inc.
 3. Mersen.
 4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.03 PLUG FUSES

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.04 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 2. Finish: Gray, baked enamel.
 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 EXECUTION

3.01 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.

3.02 FUSE APPLICATIONS

1. Refer to schedules on drawings for descriptions of fuses in each application.

3.03 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).

3.04 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

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**SECTION 26 2816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

PART 1 GENERAL

1.01 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.

1.02 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers (MCCBs).
 - 4. Enclosures.

1.03 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.04 SUBMITTALS

- A. 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.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. 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.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. 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.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.06 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 and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet (201168 cm).

1.07 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

2.01 FUSIBLE AND NON-FUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. If a local disconnecting means is installed on the secondary side of the VFD, then an auxiliary contact inside the disconnecting means shall be wired back to the VFD safety shutdown circuit that shall shut down the VFD. This control wiring shall be in a separate conduit from the motor power feed.

2.02 MOLDED-CASE CIRCUIT BREAKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of 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. 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 I2t response.
- E. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- F. Features and Accessories:
 - 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: Integral communication module with functions and features compatible with power monitoring and control system, specified in Division 26 Section "Electrical Power Monitoring and Control."
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: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO 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 ground-fault 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: ; 120-V ac.

2.03 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,.
 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.

PART 3 EXECUTION

3.01 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.

3.02 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 Division 26 Section "Vibration Controls for Electrical Systems."
- 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.

3.03 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "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.

3.04 FIELD QUALITY CONTROL

- A. 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.
- B. 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. 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.
- E. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION

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**SECTION 26 4113
LIGHTNING PROTECTION FOR STRUCTURES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. UL 96 - Lightning Protection Components; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. This Section includes lightning protection for buildings.

1.04 DEFINITIONS

- A. LPI: Lightning Protection Institute.
- B. NRTL: National recognized testing laboratory.

1.05 SUBMITTALS

- A. Product Data: For air terminals and mounting accessories.
- B. Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
- C. Final report of required testing.

1.06 QUALITY ASSURANCE

- A. Contractor Qualifications: Contractor shall have personnel on staff that are certified by LPI as a Master Installer/Designer.
- B. Installers: Journeyman or higher personnel shall provide on-site supervision of the installation.
- C. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

1.07 PERFORMANCE

- A. Contractor shall design a complete lightning protection system including all components described in Part 2 below.

1.08 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Approved Lightning Protection Co., Inc.
 2. Independent Protection Co.
 3. Thompson Lightning Protection, Inc.
 4. Robbins Lightning, Inc.
 5. Bonded Lightning Protection Systems, Ltd.
 6. VFC Inc.
 7. Erico Products Inc.

8. Harger, Inc.
9. Lyncole.
10. East Coast Lightning Protection, Inc.

2.02 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. All materials shall comply in weight, size, and composition with the requirements of the UL 96 Materials Standards. All equipment shall be UL listed and properly labeled. The system furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection equipment and a member of LPI. Equipment shall be the manufacturer's latest approved design of construction to suit the application where it is to be used in accordance with accepted industry standards and with NFPA, LPI, & UL requirements. Comply with UL 96.
- B. XIT Grounding System
 1. A Lyncole XIT Grounding System shall be installed at Electrical Service Entrance. Either a vertical or horizontal 10' unit shall be used. Lyncole part numbers K2-10CSD, or K2L-10CSD.
 2. A Main Ground bar shall be installed at the electrical service with minimum dimensions of ¼" x 4" x 24" with 2 hole lug spacing.
- C. Lightning Protection
 1. Class I materials shall be used for systems on structures not exceeding 75 feet (2286 cm) in height and Class II materials shall be used for systems on structures exceeding 75 feet above grade.
 2. Copper shall be of the grade ordinarily required for commercial electrical work, generally designated as being 95 percent conductive when annealed.
 3. Lightning protection materials shall be coordinated with building construction materials to assure compatibility. Aluminum lightning protection materials shall not be embedded in concrete or masonry, installed on or below copper surfaces, or used for the in-ground system. Copper lightning protection materials shall not be installed on aluminum surfaces or on exterior sheet metal surfaces. Copper system components within 2 feet (60.96 cm) of chimney exhausts shall be tin coated to protect against deterioration.
 4. Strike termination devices shall be provided to place the entire structure under a zone of protection as defined by the Standards. Air terminals shall project a minimum of 10 inches (254 mm) above protected areas or objects. Air terminals shall be located within 2 feet (60.96 cm) of exposed corners and roof edges.
 5. Metallic bodies having a thickness 3/16" or greater may serve as strike termination devices without the addition of air terminals. These bodies shall be made a part of the lightning protection system by connection(s) according to the Standards using main size conductors and bonding fittings with 3 square inches of surface contact area.
 6. Cable conductors shall provide a two-way path from strike termination devices horizontally and downward to connections with the ground system. Cable conductors shall be free of excessive splices and sharp bends. No bend of a conductor shall form a final included angle of less than 90 degrees or have a radius of bend less than 8 inches (203.2 mm). Structural elements and design features shall be used whenever possible to minimize the visual impact of exposed conductors.
 7. Cable down conductors may be concealed within the building construction or enclosed within PVC conduit from roof to grade level. Down conductors shall be spaced at intervals averaging not more than 100 feet (3048 cm) around the protected perimeter of the structure. In no case shall any structure have fewer than two down conductors. Where down conductors are exposed to environmental hazards at grade level, guards shall be used to protect the conductor to a point 6 feet (182.88 cm) above grade.
 8. In the case of structural steel frame construction, cable down conductors may be omitted and roof conductors shall be connected to the structural steel frame at intervals averaging not more than 100 feet (3048 cm) around the protected perimeter of the structure.

9. Exposed cable conductors shall be secured to the structure at intervals not exceeding 3 feet (91.44 cm) – 0 inches (0 mm).
 10. All fasteners to be VFC Z-Pen #ZP3412 with appropriate loop supports. No support penetrations shall be made in any sheet metal flashing or roof top equipment. Sheet metal screws shall not be used. Appropriate adhesive supports and construction mastic may be used on Membrane roof surfaces only. Adhesive supports and construction mastic shall not be used on any sheet metal surfaces.
 11. Connectors and splicers shall be of suitable configuration and type for the intended application and of the same material as the conductors or of electrolytically compatible materials.
 12. Ground terminations suitable for the soil conditions shall be provided for each downlead conductor. Where the structural steel framework is utilized as main conductors for the system, perimeter columns shall be connected to the grounding system at intervals averaging 60 feet (1828.8 cm) or less on the protected perimeter. For any structure in excess of 60 feet (1828.8 cm) in vertical elevation above grade, a ground loop interconnecting all ground terminals and other building grounded systems shall be provided.
 13. Common interconnection of all grounded systems within the building shall be accomplished using main size conductors and fittings. Grounded metal bodies located within the calculated bonding distance as determined by the formulas of the Standards shall be bonded to the system using properly sized bonding conductors.
- D. Roof-Mounting Air Terminals: NFPA Class I or 2, as applicable, copper, solid tubular, unless otherwise indicated.
1. Single-Membrane, Roof-Mounting Air Terminals: Designed for single-membrane roof materials.
- E. Stack-Mounting Air Terminals: Solid copper
- F. Provide bronze cable connections and splices..
- G. Ground Rods, Ground Loop Conductors, and Concrete-Encased Electrodes: Comply with Division 26 Section "Grounding and Bonding for Electrical Systems" and with standards referenced in this Section.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install lightning protection components and systems according to LPI 175, UL 96A and NFPA 780. Comply with manufacturer's installation instructions.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.
- C. Conceal the following conductors:
 1. System conductors.
 2. Down conductors.
 3. Interior conductors.
 4. Conductors within normal view from exterior locations at grade within 200 feet (6096 cm) of building.
 5. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- D. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.
- E. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
- F. Bond extremities of vertical metal bodies exceeding 60 feet (1828.8 cm) in length to lightning protection components.

- G. A counterpoise installation based on requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" may be used as a ground loop required by NFPA 780, provided counterpoise conductor meets or exceeds minimum requirements in NFPA 780.
 - 1. Bond ground terminals to counterpoise conductor.
 - 2. Bond grounded metal bodies on building within 12 feet (365.76 cm) of ground to counterpoise conductor.
 - 3. Bond grounded metal bodies on building within 12 feet (365.76 cm) of roof to interconnecting loop at eave level or above.
- H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.02 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.03 FIELD QUALITY CONTROL

- A. UL Inspection: Provide inspections as required to obtain a UL Master Label for system.
- B. Provide an inspection by an inspector certified by LPI to obtain an LPI certification.

3.04 TESTING

- A. Upon completion of installation of lightning protection system, test resistance-to-ground (earthing connection) with resistance tester. Where tests indicate resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms or less, by driving additional, properly spaced rods, and treating soil in proximity to ground rods with common salt, copper sulfate or magnesium sulfate. Then retest to demonstrate compliance.

3.05 FINAL REPORT

- A. Submit a final report, based on industry standards, that includes the following:
 - 1. As-Built drawings stamped by an LPI or NRTL certified master designer.
 - 2. Final systems to ground resistance level.
 - 3. Testing of the internal bonding and grounding systems.
 - 4. Testing of the equipment grounding.
 - 5. Copy of the LIP certification.

3.06 PERSONNEL TRAINING

- A. Building Maintenance Personnel Training: Train Owner's building maintenance personnel in procedures for testing and determining resistance-to-ground values of lightning protection system. Also instruct maintenance personnel in preparation and application of chemical solution for earth surrounding grounding rods for reducing ohmic resistance to required levels.

END OF SECTION

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SECTION 26 4313
SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.
- B. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Sections:
 - 1. Division 26 Section "Wiring Devices" for devices with integral SPDs.

1.04 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. VPR: Voltage Protection Rating.
- C. SPD: Surge Protection Device.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. Comply with IEEE C62.41.1-2002, C62.41.2-2002 and test devices according to IEEE C62.45-2002.
- C. Comply with UL 1449 Third Edition.
- D. Comply with NFPA 70.
- E. Comply with NEC Article 285.
- F. Comply with UL 1283 Fifth Edition.

1.07 PROJECT CONDITIONS

- A. Service Conditions: Rate SPD for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet (609600 cm) above sea level.

1.08 COORDINATION

- A. Coordinate location of field-mounted SPDs to allow adequate clearances for maintenance.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of the surge protective devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten (10) years from date of Substantial Completion.
- B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

PART 2 PRODUCTS

2.01 SERVICE ENTRANCE SUPPRESSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Advanced Protection Technologies, Inc
 2. Current Technology Inc.; ABB/Thomas & Betts.
 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit
 4. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 5. Liebert Corporation; a division of Emerson Network Power.
 6. Siemens Energy & Automation, Inc.
 7. Square D; a brand of Schneider Electric.
 8. Surge Suppression Incorporated.
- B. Service entrance surge protective devices shall not be installed in switchboards or panels.
- C. Surge Protection Devices:
 1. Comply with UL 1449 Third Edition.
 2. The SPD shall have a Short Circuit Current Rating (SCCR) of 200kA. Fuse ratings shall not be considered in lieu of demonstrated withstand testing of the SPD, per NEC Article 285.6.
 3. Fabrication using bolted compression lugs for internal wiring.
 4. Integral disconnect switch if no breaker position is available.
 5. Redundant suppression circuits.
 6. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
 7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 8. LED indicator lights for power and protection status.
 9. Audible alarm, with silencing switch, to indicate when protection has failed.
 10. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 11. Six-digit transient-event counter set to totalize transient surges.
 12. SPD shall be UL labeled as Type 1 or Type 2 (verifiable at UL.com). Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying on external of supplementary installed safety disconnectors do not meet the intent of this specification.
 13. The UL 1449 Nominal Discharge Surge Current Rating shall be 20kA.
- D. Peak Single-Impulse Surge Current Rating: 250 kA per mode/500 kA per phase.
- E. Protection modes and UL 1449 Third Edition VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:
 1. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
 2. Line to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
 3. Neutral to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.

2.02 NON SERVICE ENTRANCE RATED SWITCHBOARD AND PANELBOARD SURGE PROTECTIVE DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Advanced Protection Technologies, Inc
 2. Current Technology Inc.; ABB/Thomas & Betts.
 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit
 4. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 5. Liebert Corporation; a division of Emerson Network Power.
 6. Siemens Energy & Automation, Inc.
 7. Square D; a brand of Schneider Electric.
 8. Surge Suppression Incorporated.
- B. Surge Protection Devices:
1. Non-modular.
 2. LED indicator lights for power and protection status.
 3. Audible alarm, with silencing switch, to indicate when protection has failed.
 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 5. The SPD shall have a SCCR of 200kA.
 6. SPD shall be UL labeled as Type 1 or Type 2.
 7. The UL 1449 Nominal Discharge Surge Current Rating shall be 20kA.
- C. Peak Single-Impulse Surge Current Rating: 100 kA per mode/200 kA per phase.
- D. Protection modes and UL 1449 Third Edition VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
 2. Line to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
 3. Neutral to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.

2.03 ENCLOSURES

- A. Indoor Enclosures: NEMA 250 Type 1
- B. Outdoor Enclosures: NEMA 250 Type 3R

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install SPDs at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install SPDs for panelboards and auxiliary panels with conductors or buses between the surge protective device and points of attachment as short (less than 24 inches (609.6 mm)) and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 1. For SPDs installed at service entrance, provide 3-pole, 100-A circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated.
 2. For SPDs installed at non service entrance rated equipment, provide 3-pole, 30-A circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Verify voltage clamping levels utilizing a diagnostic test kit, comparing factory readings to installed readings.
 2. After installing SPDs but before electrical circuitry has been energized, verify service and separately derived system neutral to ground bonding jumpers per NEC.
 3. Complete startup checks according to manufacturer's written instructions.
- B. The SPD will be considered defective if it does not pass tests and inspections.

- C. Compile and maintain all field quality control reports and make available to the AHJ, owner, architect and engineer as needed.

3.03 STARTUP SERVICE

- A. Do not energize the SPD until the XO and N-G bonding is verified. Do not energize or connect service entrance equipment or panelboards to their sources until the SPDs are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.04 DEMONSTRATION

- A. Train Owner's maintenance personnel to maintain SPDs.

END OF SECTION

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Uniform General Conditions, Supplementary General Conditions, and Division 1 General Requirements apply to this Section.
- B. Section includes project description, definitions, references, contractor qualifications, supervision, equipment and materials, minimum requirements, workmanship, warranty, coordination drawings, storage and protection of materials, cutting and Patching, concealment, rough-in, and submittals.
- C. Each Section following, including this, is an integrated part of a whole. No section shall be issued alone. Parts 1 and 2 of each Section may contain descriptions of general information and approved materials that are typically used industry-wide but are not specifically part of this project. Part 3 - Execution of each Section, together with the drawings, identifies the installation procedures for components included in this project. A brief synopsis of the work included in this project also follows below in Section 1.3.
- D. The work covered by the communications specifications shall include furnishing all materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of all communications work required in the contract documents and specified herein. The contract documents intend to provide complete installation in every respect. If additional details or special construction may be required for the work indicated or specified in this Section or work specified in other sections, the Contractor shall be responsible for providing all material and labor to make the installation complete and operative.
- E. All phases of work shall be sequenced under Section 01110, and the Contractor shall be responsible for the coordination and proper relation of his work to the building structure and other trades. Before the installation, the Contractor shall provide detailed plans showing the coordination of pathways and termination equipment with Mechanical, Plumbing, and Electrical drawings. Voice and Data Communications systems shall be independent of any other systems.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Division 27 Sections include:
 - A. 270500 Common Work Results
 - B. 270526 Grounding and Bonding
 - C. 270528 Pathways for Communications Systems
 - D. 270553 Identification for Communications Systems
 - E. 271100 Communications Equipment Room Fittings
 - F. 271500 Communications Horizontal Cabling
 - G. 271600 Patch Cords, Station Cords, & Cross-Connect Wire
 - H. 272000 Data Communications Equipment
 - I. 273000 Voice Communications Equipment
 - J. 274000 Audiovisual System

1.3 REFERENCES

- A. Codes and Standards (Latest issue and addenda)
 - 1. ADA Standards for Accessible Design 28 CFR Part 36
 - 2. U.S. Department of Labor Occupational Safety & Health Administration (OSHA)
 - 3. UNT Telecommunications and Infrastructure Requirements
 - 4. BICSI TDM 11th Edition

5. National Electric Code (NEC), Latest Issue
6. ANSI/TIA568-C.1 - Commercial Building Telecommunications Cabling Standard*
7. ANSI/TIA568-C.2 - Commercial Building Telecommunications Cabling Standard*
8. ANSI/TIA568-C.3 - Optical Fiber Cabling Components Standard*
9. ANSI/TIA569-C - Commercial Building Standard for Telecommunications Pathways and Spaces*
10. ANSI/TIA 606-B - Administration Standard for Commercial Telecommunications Infrastructures, June 21, 2002*
11. ANSI J-STD-607-A, Commercial Building. Grounding/Bonding Requirements- Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002*
12. ANSI/TIA758-B - Customer-owned Outside Plant Telecommunications Infrastructure Standard, May 2005*
13. International Standards Organization/International Electrotechnical Commission (ISO/IEC) IS 11801, 2000*
14. Underwriters Laboratories (UL) Cable Certification and Follow-Up Program*
15. National Electrical Manufacturers Association (NEMA)*
16. American Society for Testing Materials (ASTM)*
17. American National Standards Institute (ANSI), ANSI T1.404 (DS3) and CATV Applications
18. Institute of Electrical And Electronics Engineers (IEEE), IEEE 802.4 Broadband Applications and 802.7 Broadband Specifications Standard
19. Federal Communications Commission (FCC), FCC Part 15 and FCC Part 76
20. National Cable Television Association (NCTA), NCTA-02.

B. Acronyms and Abbreviations

1. ADA Americans with Disabilities Act
2. AKA Also Known As
3. ANSI American National Standards Institute
4. AP Access Provider
5. ASTM American Society for Testing and Materials
6. AWG American Wire Gauge
7. BICSI Building Industry Consulting Services International
8. CATV Community antenna television
9. CO-OSP customer-owned outside plant
10. EF Entrance facility
11. EIA Electronic Industries Alliance
12. EMI Electromagnetic interference
13. FCC Federal Communications Commission
14. HVAC heating, ventilation, and air conditioning
15. IEEE The Institute of Electrical and Electronics Engineers
16. ITS Information Technology System
17. ISO International Organization for Standardization
18. LAN local area network
19. Mb/s megabits per second
20. MC main cross-connect, AKA Main Distribution Frame (MDF)
21. MDF main distribution frame, AKA main cross-connect (MC)
22. NEMA National Electrical Manufacturers Association
23. NESCÒ National Electrical Safety Code
24. NFPA National Fire Protection Association
25. OFOI Owner Furnished Owner Installed
26. RCDD Registered Communications Distribution Designer
27. SCS Structured Cabling System
28. TBB Telecommunications bonding backbone
29. TR Telecommunications room, AKA Intermediate Distribution Frame (IDF)
30. TGB Telecommunications grounding busbar
31. TMGB Telecommunications main grounding busbar
32. TIA Telecommunications Industry Association
33. UL Underwriters Laboratories
34. UTP Unshielded twisted-pair
35. WA Work area
36. WAP wireless access points
37. X cross-connect

1.4 PROPOSAL SUBMITTALS

- A. See Section 01-30-00 - Administrative Requirements for submittal procedures.
- B. Follow Division 1 and this Section. All submittals shall be reviewed and stamped by the Contractor's project RCDD.
- C. Submit a resume and copy of the Building Industry Consulting Services International (BICSI) Registered Communication Distribution Designer (RCDD) certificate for the Contractor's project RCDD.
- D. A list of technical product education (training) completed by the Contractor's project personnel.
- E. All installation team members must be certified by the Manufacturer as having completed the necessary training to complete their part of the installation. Submit resumes of the entire team, completed training courses, and copies of BICSI Installer certificates TE300, training course IN100, and IN200.
- F. Cable tester manufacturer or a third-party certification for copper and fiber cable test technicians.
- G. Price Quotation Information -
 - 1. Itemized Unit Pricing for Labor and Material;
 - 2. Itemized Add/Deduct Unit Pricing for Labor and Material for Pre- Cutover (200' average length) ONE (1) CAT 6 Drop;
 - 3. Itemized Add/Deduct Unit Pricing for Labor and Material for Post-Cutover (200' average length) ONE (1) CAT 6 Drop;
 - 4. Itemized Add/Deduct Unit Pricing for Labor and Material for Pre-Cutover (200' average length) TWO (2) CAT 6 Drop;
 - 5. Itemized Add/Deduct Unit Pricing for Labor and Material for Post-Cutover (200' average length) TWO (2) CAT 6 Drop;
 - 6. Itemized Add/Deduct Unit Pricing for Labor and Material for Pre- Cutover (200' average length) FOUR (4) CAT 6 Drop;
 - 7. Itemized Add/Deduct Unit Pricing for Labor and Material for Post-Cutover (200' average length) FOUR (4) CAT 6 Drop;
- E. The Contractor shall review paragraph 1.3 of this Section; Codes and Standards - Latest issue and addendums and state understanding and compliance or exception.
- F. Product Data: For each type of product indicated below. Product data to include, but not limited to, materials, finishes, approvals, load ratings, and dimensional information.
 - 1. Submittals shall include the manufacturer cut sheets for the following:
 - a. Equipment enclosures and/or racks;
 - b. Fiber optic and balanced twisted pair cable;
 - c. Patch cords and cross-connect media;
 - d. Connectors and termination hardware;
 - e. Protection hardware;
 - f. Fire-stopping materials;
 - g. Test equipment to be used for fiber and balanced twisted pair channels;
 - h. Cable tray and cable support hardware.
- G. Product Data Manufactures literature sheets for all materials and equipment, including a copy of the proposed warranty, recommended preventative maintenance, and spare part inventory recommendations. Literature containing more than one device shall be marked to delineate the item(s) included in the work. Indicate color or special finishes.
- H. Manufacturer and Contractor statement of RoHS: Restriction of Certain Hazardous Substances Compliance.
- I. Design and Installation Certificates: The local cable manufacturer's representative signifies that the design is acceptable to the cable manufacturer's Design Engineer(s) and that the manufacturer authorizes the Contractor to install a registered (warranty) cabling system.

1.5 DESCRIPTION OF PROJECT

- A. Main Distribution Frame (MDF) – Located on Level 2 of the Facility.
- B. Pathways - The electrical Contractor will install conduits. One (1) 1" EMT conduit will be placed from each communications device outlet into the ceiling spaces and terminate within 6" above the nearest cable tray where practical. The conduit will be attached to the underside of the roof structure above the ceiling and the cable tray and will include a bushing-type coupler at the connection point. All conduit stub-ups will be terminated above into accessible ceiling spaces. Cabling, not in conduit or cable tray placed above the ceiling in the Health Professionals Building 1, will be supported on 48" maximum centers using J-hooks (see Section 270528).
- C. Horizontal cabling – Typical Data Outlet will consist of two (2) Data Cables. All horizontal cabling shall be plenum-rated.
- D. Riser/Backbone/Tie Cabling - Multi-pair voice cabling and fiber optic backbone cables are required between the existing campus network and the new MDF, as well as between the MDF and each Telecom Room in the building. Copper and fiber optic backbone cable sizes are established in Section 271300-0 and Telecommunications Detail Drawings.
- E. Relay Racks - All cabling shall be terminated to patch panels (data) mounted to 19"x7'0" floor-mounted relay racks in the ER and each TR. Refer to Telecommunications Detail Drawings for specifics. Section 271100 establishes the requirements for the communications racks.

1.6 SUBMITTALS FOR PROJECT RECORD

- A. Follow Division 1 and this Section.
 - 1. Drawings: As-built documentation must be submitted five (5) business days before obtaining approval for cutover to any portion of the new cable plant system. Furnish for review and comments four complete sets of E size (30 by 42), four complete sets of C size as-built drawings, and 4 CDs containing all electronic AutoCAD 2000 or newer (DWG) files.
 - 2. Final approved Shop Drawings: Include plan and elevation of TRs, cable pathway details, cable locations, and cable ID#.
 - 3. 4 sets of cable inventory data must be submitted for all copper and fiber termination hardware (before cutover to the new cable plant if applicable.) Submit data in binders and electronically on CDs in "Microsoft Excel " format, listing products furnished, including:
 - a. Manufacturer's name and part numbers.
 - b. Cable numbers utilizing the Owner's cable numbering standard.
 - c. Location and riser assignments.
 - 4. Manufacturer Certificates: Within ten days of completion of the project, the Contractor shall deliver a letter signed by local Structured Cabling Components representatives and the Contractor's RCDD stating that the installed cabling system complies with all requirements specified in manufacturer's installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.
 - 5. Test Reports: 4 sets of hard copies with four copies on CD in compliance with related Test Result Documentation.
 - 6. Submitted test results and non-compliant submittals will be reviewed and returned to the Contractor with comments.
 - 7. Re-submitted test results and non-compliant submittals will be reviewed and returned to the Contractor with comments.
 - 8. Manufacturer's warranty to the Owner. This shall include, but not be limited to, the owner's name and the project name and address. (Within three weeks of substantial completion).
 - 9. Within ten days of completion of the project, the Contractor shall deliver a letter signed by a local SCS Manufacturers representative and Contractor's RCDD stating that the installed cabling system complies with all requirements specified in installation guidelines and that there were no accidents, improper installation, mishandling, misuse, damage while in transit, unauthorized alteration, unauthorized repair, failure to follow instructions, or misuse with the structured cabling system that could adversely impact warranty.

10. Within 30 days of completion of a project, the communications contractor and/or the manufacturer's local representative will provide the owner with The Structured Cabling Performance Warranty signed by the manufacturer. The warranty shall list the owner and name of the Facility, including location, as the holder of the warranty.

1.7 DEFINITIONS

- A. MER - Main Equipment Room: The main room typically contains the PBX, MDF, and main Data Communications equipment.
- B. TR - Telecommunications Room: Any additional room that contains switches, hubs, patch panels, and cross-connects away from a central location to serve areas out of distance from the MER.
- C. TO - Telecommunications Outlet: Point of connectivity for voice, data, or video on the wall or the floor. Refer to Telecommunications Drawings and Symbol sheet(s) for quantities and media types at each outlet.
- D. MDF - Main Distribution Frame: A termination frame for unshielded twisted pair cable, usually providing a connection field for PBX telephone ports and feeder/riser cables to TRs. The MDF is normally located in the MER.
- E. IDF - Intermediate Distribution Frame: A termination frame for unshielded twisted pair cabling providing a connection field for horizontal wiring from the workstation and feeder/riser cables extended from the MER.
- F. PBX - Private Branch Exchange: Privately owned voice communications switch.
- G. STUBBED OUTLET - A flush device box, 4-11/16" x 4-11/16" x 2-1/8" deep, with a single-gang extension ring installed behind sheet-rock walls or within concrete block walls. There shall be two (2) conduits a minimum of 1" installed to each device box (See drawing T3.03.05). The device box is centered at 18" a.f.f., and the conduit(s) rise to a point above the suspended ceiling or continue to an accessible ceiling for cable installation. The electrical Contractor provides this work.
- H. PROJECT MANAGER - An individual who manages the logistic requirements of projects, such as personnel, material, and schedules. This individual may be responsible for multiple projects.
- I. SUPERVISOR - An individual responsible for a specific project and is on-site for 95% of the workday. This individual manages personnel assigned to the project, ensures that materials are ordered, received, and installed on time, and ensures the overall quality of the project. This individual must be a Registered Communications Distribution Designer in good standing with BICSI. Successful completion of the BICSI IST100 training course in addition to TE300 is required.
- J. LEAD TECHNICIAN - An individual in charge of up to 4 technicians. This individual is responsible for timely project completion and quality assurance. Completing the BICSI TE300 training course and all its prerequisites is required.
- K. TECHNICIAN, LEVEL II (Installer, Level 2) - An individual who possesses the training and skills necessary to qualify for and has successfully passed the BICSI IN200 training course requirements. This individual is responsible for his or her work plus the work of not more than one (1) level 1 installer.
- L. TECHNICIAN, LEVEL I (Installer, Level 1) - An individual who possesses the training and skills necessary to qualify for and has successfully passed the BICSI IN100 training course requirements.

1.8 CONTRACTOR QUALIFICATIONS

- A. General Qualifications
 1. Untrained, undocumented, or otherwise unqualified personnel cannot perform any portion of the communications infrastructure installation.

2. All personnel must be permanent employees of the telecommunications contractor or approved sub-contractors.
- B. Voice/Data
1. The Contractor shall have been in the telecommunications business continually for at least five years.
 2. A minimum of five (5) representative educational facilities projects must be submitted as references to include the school's name, address, architect or Engineer, cost of the project, and the contact person at the school district, including phone number.
 3. The Telecommunications contractor shall own and possess at least one copy of ANSI/TIA Telecommunications Building Wiring Standards, latest issue. Available from Global Engineering Documents, telephone (800) 624-3974, and the internet address www.global.ihs.com.
 4. The Telecommunications contractor shall own and possess at least one copy of the BICSI Telecommunications Distribution Methods Manual, latest issue, available from BICSI (Building Industry Consulting Services International) telephone (800) 242-7405, internet address www.bicsi.org.
 5. Telecommunications contractor shall possess current certifications from CommScope/Systemax
 6. All project managers, supervisors, lead technicians, and technicians for the telecommunications contractor shall each possess individual certification(s) for installing and testing CommScope/Systemax voice/data and fiber optic cabling products.
 7. Supervisor(s) shall possess BICSI certificates of completion for training courses IS100 and TE300.
 8. Strongly Recommended: Lead Technicians shall possess BICSI certificates of completion for the training course TE300.
 9. Strongly Recommended: Technicians shall possess BICSI certificates of completion for the training courses IN200 or IN100 for Installer Level 2 or Installer Level 1.
- C. Audio/Video
1. Five (5) years of experience installing broadband distribution systems, including splicing, terminating, and testing copper coaxial cable.
 2. Five (5) installed systems, comparable to the Owner's installation, where broadband distribution systems are installed, and the systems have been in continuous satisfactory operation for at least one (1) year. The Contractor shall submit as proof supporting documents and the names, addresses, and telephone numbers of the operating personnel who can be contacted regarding the installed systems.
 3. A minimum of five (5) representative educational facilities projects must be submitted as references to include the school's name, address, architect or Engineer, cost of the project, and the contact person at the school district, including phone number.
 4. Installers must have been trained and experienced in the specific splicing, terminating, and testing equipment for installation. The Contractor shall possess all relevant certifications required by the manufacturer before installing the manufacturer's specific products. The Contractor shall provide a list of their technical support staff, work experience, training history, and manufacturer's certification.
 5. Qualified Contractors shall submit proof of all certifications and experience details with a bid response.

1.9 SUPERVISION

- A. All work performed under Division 27 shall be continuously supervised at the project site by a Registered Communications Distribution Designer (RCDD) in good standing with Building Industry Consulting Service International (BICSI).
- B. The Project Manager shall be the main point of contact for the project between the Owner and the Owner's assignee.
- C. The Contractor's Project Manager shall attend a pre-installation meeting with the Owner and design team before working on the project.
- D. The site supervisor shall be assigned to the project site for 95% of the work week and shall be responsible for managing Lead Technicians.

- E. The Lead Technician shall be responsible for the direct supervision of not more than four (4) total Technicians, either Level II or Level 1.
- F. A Technician, Level II shall be directly responsible for not more than one (1) Technician, Level 1.

1.10 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS

- A. All wiring, materials, and equipment must be listed and labeled by a nationally recognized testing laboratory.
- B. Original Equipment Manufacturer (OEM) documentation must be provided to the Owner's Telecommunications Technical Representative, who certifies performance characteristics that meet TIA standards.
- C. The Contractor shall structure and equip the cable and wire system to minimize vulnerability to single points of failure.
- D. All parts shall be made of corrosion-resistant materials, such as plastic, anodized aluminum, or brass.
- E. All materials used in the installation shall be resistant to fungus growth and moisture deterioration.
- F. An inert dielectric material shall separate dissimilar metals apt to corrode through electrolysis under the specified environmental operating conditions.
- G. The Contractor shall ensure that the wire and cable allow detection and diagnosis of problems to achieve high reliability and availability.
- H. The wiring, materials, and equipment furnished for this request shall be essentially the standard product of the Manufacturer.
- I. Firestop all rated wall penetrations according to code requirements and industry standards.

1.11 WORKMANSHIP

- A. All work shall be performed in a neat, workmanlike manner.
- B. Cable trunks (bundles) shall be routed along or perpendicular to building lines.
- C. Cable trunks shall be placed above installation-convenient pathways such as hallways.

1.12 WARRANTY

- A. The Contractor and Manufacturers shall provide a ONE (1) YEAR guarantee for all work under the Telecommunications Trade. However, such guarantees shall be in addition to and not in place of all other liabilities that the Manufacturer and Contractor may have by law or other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the telecommunications system, as the Engineer determines. They shall remain in effect for ONE (1) YEAR after that.
- B. All materials, items of equipment, and workmanship furnished under each Section shall carry a ONE (1) YEAR warranty against all defects in material and workmanship. Any fault under any Contract due to defective or improper material, equipment, workmanship, or design which may develop shall be made good, forthwith, by and at the expense of the Contractor for the work under his Contract, including all other damage done to areas, materials, and other systems resulting from this failure.
- C. The Contractor shall guarantee that all elements of the system, which are to be provided under his

- Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.
- D. Upon receipt of notice from the Owner of the failure of any part of any systems or equipment during the guarantee period, the Contractor shall replace the affected part or parts for his respective work, as applicable.
 - E. An additional extended warranty is required for work on this project. The additions and/or extensions to the standard year guarantee previously described are to be provided in writing by the Manufacturers. The warranty is to cover all parts and labor as specified below:
 - 1. Certified SYSTIMAX 25-year performance certification for:
 - a. Category 6, horizontal and backbone copper cable and associated labor.
 - b. Category 6, patch panels, blocks, and associated labor.
 - c. Category 6, data workstation outlets and associated labor.
 - F. Furnish, before the final payment is made, a written guarantee covering the above requirements.
 - G. Additional/extended warranty listed above is Non-negotiable and cannot be amended through the submittal process.

1.13 COORDINATION DRAWINGS

- A. It shall be the Contractor's responsibility to consult the Architectural and Engineering Drawings and Details, thoroughly familiarizing himself with the type and quality of construction to be provided on this project.
- B. The Telecommunications Drawings are diagrammatic in character and cannot show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of local ordinances and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and coordinate with all other trades to avoid interference between the various phases of work.
- C. The approximate location of Telecommunications items is indicated on the Telecommunications Drawings. These drawings are not intended to give complete and exact details regarding the location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the job site and will, in all cases, be subject to the approval of the Architect. The Architect reserves the right to make reasonable changes in the location indicated without additional cost.

1.14 STORAGE AND PROTECTION OF MATERIALS

- A. Wiring, materials, and equipment shall be delivered and stored in a clean, dry space.
- B. All materials shall be properly packaged in factory-fabricated containers and protected from damaging fumes, construction debris, and traffic until job completion.
- C. Refer to Division 1 for additional information.

1.15 CUTTING AND PATCHING

- A. Where it becomes necessary to cut through any wall, floor, or ceiling to install any work under this Section of the Contract or to repair any defects that may appear up to the expiration of the guarantee period, such cutting shall be done under the supervision of the Architect/Engineer by the Contractor. The Contractor shall not be permitted to cut or modify any structural members without the written permission of the Architect/Engineer.

- B. Patching of all openings cut by the Contractor or repairing any damage to the work of other trades caused by cutting or failure of any part of the work installed under this Contract shall be performed by the appropriate trade. Still, it shall be paid for by the Contractor.
- C. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills at locations acceptable to the Architect/Engineer. Impact-type equipment shall not be used except where specifically acceptable to the Architect/Engineer.
- D. All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved and shall match the remaining surrounding materials and/or finishes.
- E. Coring through slabs after concrete placement requires an X-ray to verify rebar location before coring. The Contractor shall bear all costs associated with coring, including but not limited to coring and X-ray inspection. The core drill shall not cut any rebar.
- F. Refer to Division 1 for additional information.

1.16 CONCEALMENT

- A. No telecommunications cable or cable tray may be installed where physical access is not attainable.
- B. If cable and/or cable tray pass through areas obstructed by sheet-rocked ceilings and/or fire-rated walls or exceeds 20' over a solid sheet-rocked ceiling area, access panels must be installed.
- C. The Contractor shall determine whether access panels are required by investigating the architectural drawings for this Contract. The Contractor shall also bear the cost of installation of any access panels.

1.17 ROUGH-IN

- A. "Rough-in" shall be defined as incomplete cable or equipment installation.
- B. Where cable is to be roughed in, the following conditions shall be met:
 - 1. Cables shall be run within active cabling bundles and dressed out the same.
 - 2. Where cables are routed into stub-outs, at least 18" of the cable shall be left coiled within the device box. The device box shall have an appropriate blank cover plate installed.
 - 3. Where no stubbed-out pathways are provided, leave roughed-in cables coiled near the center of the growth area with enough slack to reach the floor plus any place in the area and a minimum of 15' for service loop.

Cables not to be terminated at patch panels in an MTR or TR shall be left coiled in the ceiling of the MTR or TR with enough slack to reach the floor plus across the MTR or TR to the opposite wall.

1.18 DOCUMENTATION

- A. Documentation shall be provided in the form of as-built drawings, cable test records, and O&M Manuals.
- B. Refer to Section 01330 Submittals Procedures
- C. Refer to Section 01340 Shop Drawings, Product Data, and Samples

1.19 SUBMITTALS

- A. Refer to Section 01340 - Shop Drawings, Product Data, Samples, and Colors.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Substitutions: See Section 01-60-00 - Product Requirements.
- B. Special Note: UNT is a Panduit/Corning-specific location and has requested that the Panduit 25-year Warranty be extended to this installation. This requires that:
 - 1. The installer of the telecommunications infrastructure should be Panduit Gold and Corning certified.
 - 2. Panduit must manufacture the jack inserts, patch panels, and accessories.
 - 3. Panduit must manufacture the Category 6 cable.
 - 4. The project shall be registered for warranty, and test data shall be submitted for acceptance by Panduit.

PART 3 EXECUTION

3.1 CABLE CONTRACTORS

- A. Cable Contractor Qualifications
 - 1. The Cable Contractor shall have a workers' compensation experience modification rating (EMR) of less than 1.0.
 - 2. The full-time on-site supervisor shall be certified by the Manufacturer of the products being installed.
 - 3. The Cable Contractor shall have installed similar systems in at least one similar project in the year prior to this bid and be regularly engaged in installing the types of systems specified in this document. The Cable Contractor shall provide the names and locations of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc.
 - 4. The Cable Contractor shall have a minimum of one (1) full-time employee on staff who is a BICSI RCDD with experience in similar projects to review and approve the design and construction plans, inspect work, and report status weekly.
 - 5. The Cable Contractor's personnel shall have a complete working knowledge of low voltage cabling applications such as, but not limited to, data, voice, video, and audiovisual network systems.
 - 6. Untrained or otherwise unqualified personnel cannot perform any portion of the communications infrastructure installation.
 - 7. The Cable Contractor's personnel must be permanent employees of the Cable Contractor or approved sub-contractors.
 - 8. The Cable Contractor shall review paragraph 1.5 B Codes and Standards - Latest issue and addendums (of this Section) and state compliance or exception to any code or standard.
 - 9. The Cable Contractor shall have been in the telecommunications cabling business for at least four years.
 - 10. Eighty percent (80%) of Cable Contractors' personnel shall have at least three years of experience installing the types of systems, equipment, and cables specified in this document.
 - 11. Fifty percent (50%) of Cable Contractors' personnel shall be certified by the specified manufacturer(s) for Telecommunication cabling installations and maintenance of the listed products.

3.2 SUBMITTALS

- A. Provide a copy of the supervising Registered Communications Distribution Designer's current certificate.
- B. Provide a copy of the proposed manufacturer's extended warranty.
- C. Provide copies of resumes for each technician, lead technician, supervisor, and project manager. Each individual's training certificates shall accompany each resume.
- D. Provide proof of ownership of the ANSI/TIA-568 standards, latest issue.

- E. Provide proof of ownership of the Telecommunications Standards and Methods Manuals, eleventh edition.
- F. Submit proposed Television Broadband Distribution System equipment and cable plant layouts, including equipment rack layouts, system schematics, and riser diagrams. All equipment, expected signal levels, and equipment signal level values must be shown.
- G. Submit records of Category 6 Cable Certification tests at the time of substantial completion.
- H. Submit records of fiber optic power Meters and OTDR (Tier Two) cable certification tests at the time of substantial completion.

3.3 RECORD DOCUMENTS

- A. Maintain Project Record documents weekly.
- B. Refer to Section 01780 Closeout Submittals for dispensation of all record documentation.
- C. Refer to Section 270553 Identification for Telecommunications Systems for details on Closeout Submittals required for warranty certification.

END OF SECTION 270500

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SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

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 specifies the Pathways for Communications Systems requirements for the University of North Texas – Kerr Hall Dining & Lobby Renovations in Denton, Texas.
- B. Communication Pathways are defined to include, but are not limited to, inner duct, conduit, pull boxes, sleeves, cable trays, support, accessories, associated hardware, and fire-stopping materials. The Electrical Engineer of Record shall make the final design and specifications for conduits.
- C. The primary horizontal cable support system will be a cable tray, installed as shown in T drawings. The cable tray will be properly grounded. Wall penetrations shall transition to properly fire-stopped 4" sleeves, then back to the cable tray.
- D. Outlets having one single cable require a single gang box that stubs up into the accessible ceiling void via one (1) 1" conduit with a pull string.
- E. Outlets with two or more cables require a double gang box with a single gang reducer that stubs into the accessible ceiling void via one (1) 1" conduit with a pull string.
- F. Conduit runs may not be longer than 100ft or have more than two 90-degree bends without using an adequately sized junction box. Insulated throat compression fittings must be used for communications conduit runs, with termination points installed with plastic or grounding bushings.
- G. Riser sleeve in ER/TRs must be installed appropriately with bushings and fire-stop.
- H. Cables shall be neatly dressed along common paths with Velcro tie wraps with voice cables separated from data cables. Maximum number of cables per bundle shall not exceed manufacturer specifications.
- I. Layout cable pathway runs in advance to determine space requirements along pathways and to ensure non-interference from other trade installations.
- J. Do not support communication pathway from or lay on a ceiling suspension system or use electrical, plumbing, or other pipes for support. Communication pathway supports shall be permanently anchored to the building structure or joist. Provide attachment hardware and anchors designed for the structure to which they are attached and suitably sized to carry the weight of the pathway and cables to be supported. Confirm with the architect and/or construction manager on installation procedures for the cable support system before implementation.
- K. Work furnished and installed by the Electrical Contractor as specified in this Section and as shown in E and T drawings includes:
 - 1. The conduits and back boxes for the work area telecommunications outlets.
 - 2. The floor poke-through hardware.
 - 3. Fire stopping of cable tray and conduit cable pathway.
- L. Work furnished and installed by the Cable Contractor as specified in this Section and as shown in E and T drawings includes:
 - 1. All j-hook pathways.
 - 2. Bonding and grounding of overhead cable runway system (ladder rack), racks, and cabinets within the ER/TR.
 - 3. Fire stopping of conduit sleeves.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Where conduit, pull boxes, cable tray, and other raceway sizes are not explicitly shown on contract drawings. All communication pathways shall be sized in accordance with the requirements of BICSI and the NEC. No conduit shall be less than 1".
- B. Conduits must be designed and installed in the most direct route possible from the telecommunications Room to the work area.
- C. All conduit ends shall have plastic bushings installed before the cable is pulled into the conduit.
- D. Conduits will not be run next to hot water lines, steam pipes, or other utilities that may present a safety hazard or cause system performance degradation.
- E. Conduits entering the Telecommunications Room should be designed and located to allow for the most flexibility in the routing and racking of cables.
- F. Conduits or conduit sleeves entering through the floor of the Telecommunications Room shall terminate four (4) inches above the finished floor.
- G. All metallic telecommunications conduits entering the Telecommunications Room, Equipment Room, or Entrance Facility shall be bonded together and bonded to the Telecommunications Main Grounding Busbar with a #6 AWG ground cable.
- H. All in-use and spare conduits entering the Telecommunications Room, Equipment Room, or Entrance Facility shall be sealed to prevent the intrusion of water, gasses, and rodents throughout the construction project. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.
- I. All conduits and cables penetrating fire-rated walls or floors must be fire-stopped.
- J. All OSP conduits and innerduct, used and spare, shall be plugged with watertight plugs at both ends to prevent water intrusion, gasses, and rodents throughout the construction project. All OSP conduits shall have pull lines rated at a minimum of 90 kg (200 lb) pulling tension installed. The pull lines must be re-pulled each time an additional cable is installed. Prior to releasing the conduit for the installation of cables, all OSP conduits must be cleaned with a brush pulled through the conduit at least two times in the same direction and swabbed with clean rags until the rag comes out of the conduit clean and dry. All OSP conduits must be tested with a mandrel to prove compliance with the sweep radius requirements throughout the conduit run. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.

2.2 CABLE HOOK SYSTEMS

- A. J-hooks should be installed 4ft to 5ft apart. Uniform spacing should be avoided to minimize problems with signal degradation.
- B. J-hooks should be supported from decking or building structures using methods approved by the manufacturer.
- C. Cable count should not exceed the manufacturer's recommended maximum. Add a separate parallel J-hook pathway should cable count require it.
- D. Acceptable Manufacturers:
 - 1. Panduit
 - 2. Hilti

2.3 CONDUITS AND FITTINGS

- A. For each communication outlet indicated, provide a complete assembly of conduit, tubing, or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components, and accessories as needed to form a complete system of the same type indicated.

- B. See SECTION 260533 - RACEWAYS, CONDUITS AND BOXES
- C. Minimum conduit size for Telecommunications Outlets shall be 1 (one) inch.

2.4 WALL AND CEILING OUTLET BOXES

- A. All wall outlets shall be mounted in a minimum of four (4) inches by four (4) inches by two and one-half (2 1/2) inches deep double gang outlet box with a single gang mud-ring.
- B. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.
- C. See SECTION 260533 - RACEWAYS, CONDUITS AND BOXES.

2.5 PULL AND JUNCTION BOXES

- A. Pull boxes used with telecommunications conduits in interior locations shall be rated NEMA- 1. Pull boxes used in damp or wet locations such as plumbing chases or out-of-doors shall be rated NEMA-3R. Pull boxes shall be installed in conduits run at an interval no greater than every 100 feet. A pull box shall be installed in conduit runs whenever there are two 90°sweeps, or a total of 180°of sweeps, in a conduit run. A pull box may not be used to change the direction of a conduit run. Any deviations from these criteria must have prior approval from UNT IT.
- B. See SECTION 260533 - RACEWAYS, CONDUITS AND BOXES

2.6 PLENUM-RATED FIBER OPTIC INNERDUCT

- A. All fiber shall be installed in 1 ¼" corrugated, non-metallic plenum-rated innerduct when not installed in conduit or in a utility tunnel tray.
 - 1. Innerduct shall be UL Listed with Flame Propagation compliant with UL 2024.
 - 2. Only the manufacturer's fittings, transition adapters, terminators, and fixed bends shall be used.
- B. Products
 - 1. White or orange, plenum-rated, UL-listed, flexible optical fiber/communication raceway.
 - 2. Recognized per NEC Articles 770 and 800 for plenum areas for optical fiber and telecommunications cables.
 - 3. Provide all fittings to form a complete integrated raceway system.
- C. Fabrication
 - 1. Footage shall be sequentially marked.

2.7 CABLE TRAY SECTIONS AND COMPONENTS

- A. General: Except as otherwise indicated, provide metal cable trays of types, classes, and sizes indicated, with splice plates, bolts, nuts, and washers for connecting units. Construct units with rounded edges and smooth surfaces in compliance with applicable standards and with the following additional construction features.
- B. Tray Sizes shall have a 4-inch minimum usable load depth, or as noted on the drawing.
- C. Straight tray sections shall have side rails fabricated as I-Beams. All straight sections shall be supplied in standard 12-foot lengths, except where shorter lengths are permitted to facilitate tray assembly lengths as shown on drawings.
- D. Tray widths shall be 18 inches or as shown on drawings.
- E. All fittings must have a minimum radius of 24 inches.
- F. Splice plates shall be the bolted type made as indicated below for each tray type. The resistance of fixed splice connections between adjacent sections of the tray shall not exceed .00033 ohms. Splice plate construction shall be such that a splice may be located anywhere within the support span without

diminishing the rated loading capacity of the cable tray.

- G Cable Tray Supports: Shall be placed so that the support spans do not exceed the maximum span indicated on drawings. Supports shall be constructed from 12-gauge steel formed shape channel members 1-5/8 inch by 1-5/8 inch with necessary hardware such as Trapeze Support Kits (9G-55XX-22SH) as manufactured by Cooper B-Line, Inc. [or engineer approved equal]. Cable trays installed adjacent to walls shall be supported on wall-mounted brackets such as B409 as manufactured by Cooper B-Line, Inc. [or engineer-approved equal].
- H. Trapeze hangers shall be supported by 1/2-inch (minimum) diameter rods.
- I. Barrier Strips: Shall be placed as specified on drawings and be fastened into the tray with self-drilling screws.
- J. Accessories - special accessories shall be furnished as required to protect, support, and install a cable tray system. Accessories shall consist of but are not limited to section splice plates, expansion plates, blind-end plates, specially designed ladder dropouts, barriers, etc.

2.8 FIRE RATED WIRING DEVICES

A. Wiring Devices:

- 1. Cables passing through fire-rated floors or walls shall pass through fire-rated wiring devices containing an intumescent insert material that adjusts automatically to cable additions or subtractions.
- 2. The device shall have an F Rating equal to the rating of the barrier in which the device is installed.
- 3. Wiring devices shall be capable of allowing a 0 to 100-percent visual fill of cables.
- 4. Wire devices shall be of sufficient size to accommodate the quantity and size of electrical wires and data cables required.
- 5. Wire devices to be provided with steel wall plates allowing for single or multiple devices to be ganged together.

B. Acceptable Manufacturers:

- 1. Specified Technologies Inc.
- 2. EZ-PATH Fire Rated Pathway
- 3. 3M

PART 3 – EXECUTION

3.1 SUMMARY

- A. The Electrical Engineer and Architect of record shall make the final design and specifications for the Communications Systems conduits.
- B. Conduits shall be reamed to eliminate sharp edges. The metallic conduit shall be terminated with an insulated bushing. Refer to ANSI/TIA/EIA-606 and Section 270553 for the administration of the pathway system.
- C. The inside of the cable tray or wireway shall be free of burrs, sharp edges, or projections that can damage cable insulation. Abrasive supports (e.g., threaded rod) shall have the portion within the tray protected with a smooth, non-scratching covering so that the cable can be pulled without physical damage. When a wireway passes through a partition or wall, it shall be an unbroken length. Installation of telecommunications cables shall not exceed the fill requirements. Openings in fire-rated walls, floors, and ceilings shall be properly fire-stopped. Barriers between power and telecommunications cables shall be installed per electrical code. Cable trays and wireways shall not be used as walkways or ladders unless specifically designed and installed for that purpose.
- D. Supports should be located where practicable so that connections between sections of the tray fall between the support point and the quarter section of the span. The support centers shall be in accordance with the load and span for the applicable class as specified in the electrical code. A support should be placed within 600 mm (2 ft) on each side of any connection to a fitting. Wireways shall be supported on 1500 mm (5 ft) centers unless designed for greater lengths.

- E. A minimum of 300 mm (12 in) access headroom shall be provided and maintained above a cable tray. Care shall be taken to ensure that other building components, e.g., air conditioning ducts) do not restrict access to trays or wireways.

3.2 MINIMUM CLEARANCES

- A. Communication Pathway minimum clearances from:
 - 1. Minimum of 1 foot parallel, 3 inches crossover from power cables and conduits.
 - 2. Minimum of 6 inches above ceiling tiles.
 - 3. Minimum of 24 inches of Hot Steam pipes, Hot water pipes, and other hot surfaces.
 - 4. Minimum of 3 feet separation from electrical panel boards.
 - 5. Minimum of 12 inches from fluorescent fixtures.
 - 6. Minimum of 6 feet separation from electrical motors and transformers.
 - 7. Minimum of 2 inches from exposed all-thread rods.

3.3 FIRE STOPPING.

- A. Provide fire-resistant materials to restore fire ratings to all wall, floor, or ceiling penetrations used in distributing and installing communications cabling systems. Coordinate fire-stopping procedures and materials with the General Contractor and Electrical Contractor.
- B. Solutions and shop drawings/submittals for fire stop materials and systems shall be presented to the General Contractor for written approval of materials before purchase and installation.
- C. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC codes for fire-stopping measures.
- D. The material chosen shall be distinctively colored to be distinguishable from other materials, adhere to itself, and remain resilient and pliable to allow for the removal and/or addition of communication cables without drilling holes in the material.
- E. The fire-stopping material shall maintain/establish the fire-rated integrity of the wall/barrier that has been penetrated.
- F. Cable Contractor shall laminate and permanently affix to the MDF wall adjacent to chases the following information:
 - 1. Name of the manufacturer of the fire stop system.
 - 2. Part & model numbers of the system and all components.
 - 3. Provide the phone numbers of the manufacturer's corporate headquarters in the U.S. and the local distributor's name and phone number.

END OF SECTION 270528

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SECTION 270553 - IDENTIFICATION OF COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified and in performing the following operations recognized as necessary for labeling the telecommunications infrastructure as described on the Drawings and/or required by these specifications.
- B. Labeling format is to be submitted to and approved by the Owner prior to implementation.

1.2 RELATED SECTIONS

- A. 270500 Common Work Results
- B. 270526 Grounding and Bonding
- C. 270528 Pathways for Communications Systems
- D. 270553 Identification for Communications Systems
- E. 271100 Communications Equipment Room Fittings
- F. 271500 Communications Horizontal Cabling
- G. 271600 Patch Cords, Station Cords, & Cross-Connect Wire
- H. 272000 Data Communications Equipment
- I. 273000 Voice Communications Equipment
- J. 274000 Audio Visual System

1.3 QUALITY ASSURANCE

- A. Identification and administration work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA - 606-B Administration Standards.
 - 2. ANSI/TIA - 569-C Pathway and Spaces
 - 3. ANSI/TIA - 568-C Telecommunications Cabling Standard.
 - 4. BICSI Telecommunications Distribution Methods Manual.
 - 5. UL 969.

1.4 TELECOMMUNICATIONS ADMINISTRATION

- A. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, Telecommunications Rooms, and other telecommunications spaces.
- B. UNT maintains a campus-wide numbering scheme for voice and data outlets and patch panels.
- C. Telecommunications Infrastructure Records must be maintained in a computer spreadsheet or in a computer database. Paper records are encouraged but are optional. A cable record is prepared for each backbone cable. The document will show the cable name and must describe the origin point and destination point of the cable. The cable record will record what services and/or connections are assigned to each cable pair or strand. An equipment record is prepared for services distributed from a particular piece of equipment, such as a router or a system, such as a telephone system PBX.
- D. UNT requires the installer to keep accurate, up-to-date Installation or Construction Drawings. At a minimum, the Installation Drawings shall show pathway locations and routing, the configuration of telecommunications spaces, including backboard and equipment rack configurations, and wiring details, including identifier assignments.
- E. UNT requires the installer to provide a complete and accurate set of as-built drawings. The as-built drawings shall record the identifiers for significant infrastructure components, including the pathways, spaces, and wiring portions of the infrastructure, which may each have separate drawings if warranted by the complexity of the installation or the scale of the drawings.

PART 2 PRODUCTS

2.1 LABELS

- A. It shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- B. It shall be preprinted or computer-printed type. Handwritten labels are not acceptable.
- C. Where insert-type labels are used, provide a clear plastic cover over the label.
- D. Outside plant labels shall be totally waterproof even when submerged.
- E. Approved Manufacturer:
 - 1. Panduit
 - 2. Brady Corporation
 - 3. Equivalent
- F. Equipment Room Copper, Fiber, and Coax Backbone Cable Labels
 - 1. Panduit Part#LS7-75NL-1 or Brady#WML-1231-292
- G. Equipment Room Copper, Fiber, and Coax Horizontal Cable Labels
 - 2. Panduit Part#LS7-75NL-1 or Brady#WML-317-292
- H. Work Area Copper, Fiber, and Coax Riser Cable Labels
 - 1. Panduit Part#LS7-75NL-1 or Brady #WML-317-292
- I. Patch Panel Labels
 - 1. Panduit Part #LS7-38-1 or Brady #CL-111-619

PART 3 - EXECUTION

3.1 IDENTIFICATION & LABELING

- A. All labels' size, color, and contrast should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and routine maintenance of the infrastructure.
 - 1. Orange – Reserved for identification of the telecommunication service demarcation point (demarc). Orange may only be used by the telephone company.
 - 2. Green – Used to identify the termination of network connections on the customer (Texas State University) side of the demarc.
 - 3. Purple – Used to identify cables originating from standard equipment, such as the telephone PBX, LAN hubs, or multiplexer.
 - 4. White – Used to identify the first-level backbone telecommunications media termination in the building containing the main cross-connect. The main cross-connect is usually in the Equipment Room. In buildings that do not contain the main cross-connect, white may be used to identify the second-level backbone terminations.
 - 5. Gray – Used to identify the building's second-level backbone telecommunications media termination containing the main cross-connect.
 - 6. Blue – Used to identify the termination of horizontal distribution cables routing from the Telecommunications Closet or Equipment Room to the Work Area. A blue color coding is only required at the TC or ER end, not at the work-area end of the cable.
 - 7. Brown – Used to identify interbuilding backbone cable terminations.
 - 8. Yellow – Used to identify termination of auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.
- B. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light) and should have a design life equal to or greater than that of the labeled component.
- C. All labels shall be printed or generated by a mechanical device.

3.2 TELECOMMUNICATION IDENTIFIERS

- A. All voice and data outlets and patch panels shall be clearly marked using permanent means. Voice and data outlets shall use the following system of numbering and labeling. Each cable shall be labeled with the MDF or IDF room number and patch panel port number, as well as the following:
- B. OUTLET

- C. DATA: Actual IDF/TR Room Number and Patch Panel Port Number.
- D. VOICE: Actual IDF/TR Room Number and 110 block position.
- E. MDF/IDF
- F. DATA: Room Number & Jack Number on Patch Panel.
- G. VOICE: Room Number and Jack ID.
- H. When more than one TC is needed per floor, the room number of the TR shall be added to the numbering scheme.
- I. When more than one data patch panel is needed per TC, the numbering scheme shall continue consecutively. Example: If two 48-port patch panels are required, the second patch panel will be labeled starting with port 49.
- J. All voice, data outlet, and port numbers must match actual room numbers. Careful consideration should be given when developing and maintaining a numbering Scheme so that the scheme matches the actual room numbers exactly, not the builder's room number.
- K. All voice and data terminations in the TCs shall be made in numerical order by room number of each jack.
- L. Outlet numbers shall be marked by permanent means on each cable at the outlet and at the TC.

END OF SECTION 270553

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SECTION 271100 - COMMUNICATION EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Uniform General Conditions, Supplementary General Conditions, and Division 1 - General Requirements apply to this Section.
- B. Section includes:
 - 1. Equipment Racks, Cabinets or Shelves
 - 2. Cable Management - vertical and horizontal
 - 3. Category 6A UTP Patch Panels

1.2 RELATED SECTIONS

- A. 270500 Common Work Results
- B. 270526 Grounding and Bonding
- C. 270528 Pathways for Communications Systems
- D. 270553 Identification for Communications Systems
- E. 271100 Communications Equipment Room Fittings
- F. 271500 Communications Horizontal Cabling
- G. 271600 Patch Cords, Station Cords, & Cross-Connect Wire
- H. 272000 Data Communications Equipment
- I. 273000 Voice Communications Equipment

1.3 SUMMARY

- A. This Section specifies the Communications Equipment Room Fittings requirements and required components.
- B. Communications Equipment Room Fittings
 - 1. The existing IT Room on Level 2 will feed the newly renovated Level 1 Dining and Lobby areas.
 - 2. Space for new horizontal copper cabling and terminating hardware mounted in existing 19" racks will be provided in the IT room.
 - 3. The existing IT room will require the following:
 - a. Adequate space for any additional copper patch panels needed.
 - b. Cable support at the existing ladder tray system.
 - c. Horizontal cable management for new copper cabling.

PART 2 PRODUCTS

2.1 Approved Manufacturers:

- A. Panduit Front Only Horizontal Wire Manager NCMHF2
- B. Panduit Mini-Com 24 port Category 6A Flat Patch Panels _ CPPL24WBLY
- C. Panduit Mini-Com 48 port Category 6A Flat Patch Panels _ CPPL48WBLY

PART 3 EXECUTION

3.1 SUBMITTALS

- A. Provide submittals according to the requirements of Division 01 and other requirements of this specification.
- B. Provide shop drawings for all telecommunications rooms showing the dimensions of all equipment to be installed as field conditions permit, including existing equipment. Telecommunications CAD

drawings will be provided. However, shop drawings shall not be "regurgitated" but shall show accurate field conditions. Do not proceed with the installation of equipment in the telecommunications rooms until the shop drawing(s) are approved.

- C. Provide product submittals for:
 - 1. Category 6A Patch Panels
 - 2. Horizontal Wire Managers

- 3.2 EQUIPMENT RACKS, CABINETS, SHELVES
 - A. Coordinate all work for final mounting locations of all equipment in existing racks.

- 3.3 CABLE MANAGEMENT
 - A. Horizontal Management
 - 1. 19-inch relay racks:
 - a. 19" Horizontal Single-sided Manager – Panduit PN# NCMHF2

- 3.4 UTP PATCH PANELS
 - A. Provide and install Category 6 patch panels in existing IDF.
 - B. Quantities shall be adequate to terminate all Category 6A UTP cables associated with each IDF plus 30% growth.

- 3.5 CABLE TIES
 - A. Use only Velcro-type cable ties to manage and secure cables within the IDFs.
 - 1. Form neat and orderly bundles of cabling in all cases where the cable is exposed to view.
 - 2. Individual cables shall not cross over or under ("divers") other cables along the length of an exposed bundle.

END OF SECTION 271100

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Specification Section 270500, Common Work Results for Communications, applies to this section.

1.2 SUMMARY

- A. This section specifies the requirements for the Communications Horizontal Cabling for the UNT Kerr Hall Dining and Lobby Renovation in Denton, Texas.
- B. All voice and data horizontal cables shall consist of plenum-rated, Category 6, 4-pair UTP copper terminated in the ER and TRs. The voice/data cables shall terminate at 48 port RJ-45 T568A. The maximum horizontal distance shall be 295 feet.
- C. All information outlets will be flush-type mounted into conduits and boxes. Typical outlets will be used in the office spaces and lab spaces. These outlets shall consist of 3 data cables unless otherwise specified. Each port in the data patch panel shall have eight conductors configured to RJ45 (ISDN) standard pin-out T568A.
- D. Outlet configurations. Single-gang mounting plate with modular openings, which might contain one or more of the following devices
 - 1. Data Jack(s) - 8-pin modular, Category 6, un-keyed, ivory, pinned to T568A standards (fully terminated).
 - 2. Blank Inserts – to be inserted in unused openings.
- E. Contractor must keep updated redline drawings and provide as-built documentation in both print and electronic formats.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Panduit

2.2 UTP COPPER CABLE

- A. Panduit Category 6A Plenum Rated CMP – Blue _ PUP6XHD04

2.3 PATCH PANELS

- A. Panduit Mini-Com 24 port Category 6A Flat Patch Panels _ CPPL24WBLY
- B. Panduit Mini-Com 48 port Category 6A Flat Patch Panels _ CPPL48WBLY

2.4 COPPER CONNECTORS

- A. Panduit Category 6A Mini-Com TX-6 Module (Green) – Data _ CJ6X88TG
- B. Panduit Category 6A Mini-Com TX-6 Module Orange) – Security Cameras _ CJ6X88TG
- C. Panduit Category 6A Mini0Com TX-6 Module (Yellow) – Wireless Access Points _ CJ6X88TG

2.5 WALL PLATES

- A. Panduit Mini-Com Faceplate Sloped – 4 ports _ CFPSL4WHY
- B. Panduit Mini-Com Blank Module _ CMBWH-X
- C. Panduit 2 Module Surface Box _ CBX2WH-AY

2.6 OUTDOOR WALL PHONE ENCLOSURE

- A. Gai-Tronic's Corporation weatherproof or surface mount enclosures for outdoor telephone.

PART 3 EXECUTION

3.1 GENERAL

- A. Follow the manufacturer's installation guidelines.
- B. All data and voice cabling and terminations and termination hardware shall be ANSI/TIA wiring configuration T568B
- C. The length of each run of horizontal cable from the administration subsystem (Telecommunications Room) to the Telecommunication Outlet shall not exceed 295 ft.
- D. The four-pair UTP cable shall be Underwriter's Laboratories (UL) listed type CMP.
- E. Pay strict attention to the manufacturer's guidelines on bend radii and maximum pulling tension during installation. Notice that the recommended minimum bend radius for a cable during installation is typically greater than the recommended bend radius after the cable is installed. This is to minimize tension and deformation as the cables pass around corners during installation. The maximum pull-force guideline for 4-pair horizontal balanced twisted pair cables is 110 N (25 lb).
- F. UTP Cabling:
 - 1. Provide a minimum of a 3-foot service loop (for re-termination) for horizontal cables. Locate the service loop where the horizontal cable run transitions to the cable tray. Place at least 12" of service loop in the outlet box.
 - 2. The horizontal distance is the cable length from the mechanical termination of the media at the horizontal cross-connect in the telecommunications room to the telecommunications outlet/connector in the work area. The maximum horizontal distance shall be 295 ft, independent of media type. The length of the cross-connect jumpers and patch cords in the cross-connect facilities, including horizontal cross-connects, jumpers, and patch cords that connect horizontal cabling with equipment or backbone cabling, should not exceed 5 m (16 ft) in length. For each horizontal channel, the total length allowed for cords in the work area plus patch cords or jumpers plus equipment cables or cords in the telecommunications room shall not exceed 10 m (33 ft).
 - 3. Cable and components shall be visually inspected for proper installation. Cable stress, such as that caused by tension in suspended cable runs and tightly cinched bundles, shall be minimized. Plenum-rated Velcro ties used to bundle cables should be applied loosely to allow the Velcro tie to slide around the cable bundle. The vector ties should not be cinched so tightly as to deform the cable sheath. Cable placement should not deform the cable sheath.
 - 4. Minimum bend radius: The minimum bend radius for the cable will vary depending on the condition of the cable during installation (tensile load) and after installation when the cable is at rest (no load).
 - 5. The minimum bend radius, under no-load conditions, for a 4-pair unshielded twisted-pair (UTP) cable shall be four times the cable diameter.
 - 6. Copper cable splicing or bridge tapping is unacceptable.
 - 7. Cables should be terminated with connecting hardware of the same category or higher. To maintain the cable geometry, remove the cable sheath only as much as necessary to terminate the cable pairs on the connecting hardware. The connecting hardware manufacturer's instructions for cable sheath strip-back shall be followed. When terminating Category 6 and higher cables, the cable pair twists shall be maintained to within 13 mm (0.5 in) from the point of termination. For best performance when terminating cable on connecting hardware, the cable pair twists should be maintained as close as possible to the point of termination.
 - 8. The Cable Contractor shall install 4-pair Category 6 plenum-rated UTP cables from the appropriate ER or TR to each outlet location as indicated on the telecommunications drawings.

3.2 SITE QUALITY CONTROL

- A. Site Testing and Inspection Agency qualifications:
 - 1. Every cabling link in the installation shall be tested in accordance with the field test specifications defined in ANSI/TIA-568-C.2-1 "Transmission Performance Specifications for 4-pair Category 6 Cabling". This document will be referred to as the "TIA Cat 6A Standard."
 - 2. The installed twisted-pair horizontal links shall be tested from the patch panel in the telecommunications room to the telecommunication wall outlet in the work area against the "Permanent Link" performance limits specification as defined in the TIA CAT 6A Standard.
 - 3. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).
 - 4. The test equipment shall comply with the accuracy requirements for level III field testers as defined in the TIA CAT 6A Document. The tester, including the appropriate interface adapter,

must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table C.2 of Annex B of the TIA CAT 6A Standard. (Table B.3 in this TIA document specifies the accuracy requirements for the Channel configuration.)

5. The test plug shall fall within the values specified in E.3.2.2 Modular test plug NEXT loss requirements of the TIA CAT 6A Standard.
 6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
 7. The tester interface adapters must be of high quality, and the cable shall not show any twisting or kinking resulting from coiling and storing the tester interface adapters. To deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The Cable Contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
 8. One hundred percent of the installed cabling links must be tested and must pass the requirements of the standards in this section. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing results of the tests for all links shall be provided in the test results documentation in accordance with the Test Result Documentation as listed below.
- B. Site Testing, Inspection, and Acceptance
1. The Pass or Fail condition for the link-under test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the link-under-test. To achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
 2. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks.
 3. A representative of the design team shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing commences.
 4. At the conclusion of field testing, at a time scheduled by the owner's representative, the owner's representative will select a random sample (up to 10%) of the installed links in each wiring closet. Under the supervision of the owner's representative, the Cable Contractor shall test these randomly selected links, and the results are to be stored per the prescriptions in the Test Result Documentation as listed below.
 5. The results obtained shall be compared to the data originally provided by the Cable Contractor. If any (one or more) of the sample test reports displays a fail or fail* result, the Cable Contractor shall resolve any conditions causing the failed test and, under the supervision of the owner's representative, shall repeat 100% of the testing and the Cable Contractor shall bear the cost.
- C. Performance Test Parameters
1. The test parameters for CAT 6A are defined in the TIA CAT 6A standard, which refers to the ANSI/TIA-568-C.2 standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value determined in the standard mentioned above.
 - a. Wire Map
 - b. Length
 - c. Insertion Loss (Attenuation)
 - d. NEXT Loss
 - e. PSNEXT Loss
 - f. ELFEXT Loss, pair-to-pair
 - g. PSELFEXT Loss
 - h. Return Loss
 - i. ACR (Attenuation to crosstalk ratio)
 - j. PSACR

- k. Propagation Delay
 - l. Delay Skew [as defined in ANSI/TIA-568-C.1; Section 11.2.4.11]
- D. Test Result Documentation
1. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.
 2. The test results records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., "as saved in the tester," at the end of each test and that these results cannot be modified at a later time. Superior protection in this regard is offered by testers that transfer the numeric measurement data from the tester to the PC in a non-printable format.
 3. The database for the completed job shall be stored and delivered on CD-ROM, including the software tools required to view, inspect, and print any selection of test reports.
 4. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
 - a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - b. The overall Pass/Fail evaluation of the link-under-test, including the NEXT Headroom (overall worst case) number.
 - c. The date and time the test results were saved in the memory of the tester.
 5. General Information to be provided in the electronic database with the test results information for each link:
 - a. The identification of the customer site as specified by the end-user.
 - b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - c. The overall Pass/Fail evaluation of the link-under-test.
 - d. The name of the standard selected to execute the stored test results.
 - e. The cable type and the value of NVP used for length calculations.
 - f. The date and time the test results were saved in the memory of the tester.
 - g. The brand name, model, and serial number of the tester.
 - h. The identification of the tester interface.
 - i. The revision of the tester software and the revision of the test standards database in the tester.
 - j. The test results information must contain information on each of the required test parameters.
 6. The detailed test results data to be provided in the electronic database for each tested link must contain the following information:
 - a. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. In this case, the PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
 - 1) Length: Identify the wire pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m (1ft), and the test limit value.
 - 2) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns), and the test limit value.
 - 3) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns), and the test limit value.
 - 4) Attenuation: Minimum test results for the worst pair.
 - 5) Return Loss: Minimum test results for the worst pair as measured from each end of the link.
 - 6) NEXT, ELFEXT, ACR: Minimum test results documentation as explained in Section IB for the worst pair combination as measured from each end of the link.
 - 7) PSNEXT, PSELFEXT, and PSACR: Minimum test results documentation for the

worst pair as measured from each end of the link.

- E. As-built drawings
 - 1. Provide three (3) copies of E and three (3) copies of C-size prints along with CADD files in .dwg or .dgn formats showing floor plans with room numbers and actual outlet locations and labeling. The deliverable is required within five business days of final cable testing.
 - 2. Red Line Drawings: The contract must keep one (1) E-size set of floor plans on-site during work hours with installation progress marked and outlet labels noted. The contractor may be asked to produce these drawings for examination during construction meetings or field inspections.

END OF SECTION 271500

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SECTION 271600 - COMMUNICATIONS CONNECTING CORDS, DEVICES & ADAPTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Uniform General Conditions, Supplementary General Conditions, and Division 1 - General Requirements apply to this Section.
- B. Section includes Materials minimum requirements, workmanship, warranty, coordination drawings, storage and protection of materials, and submittals.
- C. Special Note: UNT is a Panduit-specific location and has requested that the Panduit 25-year Warranty be extended to this installation. This requires:
 - 1. The installer of the telecommunications infrastructure is to be a certified Panduit Gold.
 - 2. Panduit manufactures Category 6A Patch Cables.
 - 3. The project shall be registered for warranty, and test data shall be submitted for acceptance by Panduit.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Specification Section 270500, Common Work Results for Communications, applies to this Section.

1.3 REFERENCES

- A. Codes and Standards (Latest issue and addenda)
 - 1. ADA Standards for Accessible Design 28 CFR Part 36
 - 2. U.S. Department of Labor Occupational Safety & Health Administration (OSHA)
 - 3. UNTHSC Telecommunications and Infrastructure Requirements
 - 4. BICSI TDM 11th Edition
 - 5. National Electric Code (NEC), Latest Issue
 - 6. ANSI/TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard*
 - 7. ANSI/TIA-568-C.2 - Commercial Building Telecommunications Cabling Standard*
 - 8. ANSI/TIA-568-C.3 - Optical Fiber Cabling Components Standard*
 - 9. ANSI/TIA-569-C - Commercial Building Standard for Telecommunications Pathways and Spaces*
 - 10. ANSI/TIA-606-B - Administration Standard for Commercial Telecommunications Infrastructures, June 21, 2002*
 - 11. ANSI J-STD-607-A, Commercial Building. Grounding/Bonding Requirements- Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002*
 - 12. ANSI/TIA758-B - Customer-owned Outside Plant Telecommunications Infrastructure Standard, May 2005*
 - 13. International Standards Organization/International Electrotechnical Commission (ISO/IEC) IS 11801, 2000*
 - 14. Underwriters Laboratories (UL) Cable Certification and Follow-Up Program*
 - 15. National Electrical Manufacturers Association (NEMA)*
 - 16. American Society for Testing Materials (ASTM)*

1.4 SUBMITTALS

- A. See Section 01-30-00 - Administrative Requirements for submittal procedures.

1.5 WARRANTY

- A. See Section 01-78-00 - Closeout Submittals for additional warranty requirements.

- B. All materials, items of equipment, and workmanship furnished under each Section shall carry a ONE (1) YEAR warranty against all defects in material and workmanship. Any fault under any Contract due to defective or improper material, equipment, workmanship, or design which may develop shall be made good, instantly, by and at the expense of the Contractor for the work under his Contract, including all other damage done to areas, materials, and other systems resulting from this failure.
- C. The Contractor shall guarantee that all elements of the system, which are to be provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.
- D. Upon receipt of notice from the Owner of the failure of any part of any systems or equipment during the guarantee period, the Contractor shall replace the affected part or parts for his respective work, as applicable.
- E. An additional extended warranty is required for work on this project. The additions and/or extensions to the standard year guarantee previously described are to be provided in writing by the Manufacturers. The warranty is to cover all parts and labor as specified below:
- F. Panduit Gold 25-year performance certification for:
 - 1. Category 6A, cable, and associated labor.
 - 2. Category 6A, patch panels, and associated labor.
 - 3. Category 6A, data workstation outlets, and associated labor.
- G. Furnish, before the final payment is made, a written guarantee covering the above requirements.
- H. Additional/extended warranty listed above is Non-negotiable and cannot be amended through the submittal process.

PART 2 PRODUCTS

2.1 Approved Manufacturers:

- | | | |
|----|---|--------|
| A. | Panduit 2 Module Surface Box | CBX2WH |
| B. | Panduit Category 6A Patch Cord (Green) | UTP6AX |
| C. | Panduit Category 6A Patch Cord (Yellow) | UTP6AX |

2.2 COPPER PATCH CABLES

- A. Category 6A copper patch cables shall be provided, one for each "wired for" data circuit as listed in Section 27 15 00 or as required otherwise by this Contract.
- B. One copper patch cable terminated with RJ-45 connectors shall be provided, one for each wired for" voice circuit as listed in Section 27 15 00 or as required otherwise by this Contract.
- C. Copper patch cables shall be of the same Category and manufacturer as the cable listed in Section 27 15 00 as necessary to meet the extended manufacturer's warranty requirements listed in Section 27 05 00.
- D. Copper patch cables shall be of variable lengths to form neat and workmanlike groups within the cable management.

PART 3 EXECUTION

3.1 COPPER PATCH CABLES

- A. Provide two (2) patch cables for each "wired for" voice/data circuit.
- C. Lengths shall be 50% 1' and 50% 15'.

END OF SECTION 271600

SECTION 272000 – DATA COMMUNICATIONS EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The requirements for the Data Communications Equipment at the Kerr Hall Lobby for The University of North Texas in Denton, Texas.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Specification Section 270500, Common Work Results for Communications, applies to this Section.

1.3 QUALITY ASSURANCE

- A. Identification and administration work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA- 606-B Administration Standards.
 - 2. ANSI/TIA-569-B Pathway and Spaces
 - 3. ANSI/TIA-568-C Telecommunications Cabling Standard.
 - 4. BICSI Telecommunications Distribution Methods Manual.
 - 5. UL 969.

1.4 SUMMARY

- A. Data Communications Equipment
 - 1. Data Communications Equipment includes customer-owned routers, servers, Ethernet switches, personal computers, printers, wireless access points, etc., required to connect the Dining Hall to the rest of the campus, the internet, and the public switched telephone network (PSTN).
 - 2. Owner provides Data Communications Equipment at UNT.
 - 3. Data Communications Equipment will be owner-furnished and owner-installed (OFOI).
 - 4. The Cable Contractor shall fully cooperate and coordinate with the Owner as required to ensure proper integration and connectivity between systems.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 COORDINATION

- A. Cable Contractor shall fully coordinate with the Owner's Data Communications Equipment providers as required to ensure proper integration and connectivity between systems.
- B. Cable Contractor shall furnish a labeled floor plan and Excel run sheet to the Owner's Voice Communications Equipment provider two weeks prior to occupancy.
- C. Cable Contractor shall furnish and install all patch cords in conjunction with the Owner's Voice Communications Equipment provider.
- D. The cable contractor shall provide adequate technician support when the Owner's data communications equipment providers are planning and installing new data equipment and connectivity.
- E. Cable Contractor shall provide adequate technician support on the first business day after Data equipment installation and connectivity.

END OF SECTION 272000

SECTION 273000 - VOICE COMMUNICATIONS EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The requirements for Voice Communications Equipment at the Dining Hall for UNT Kerr Hall Lobby in Denton, Texas.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Specification Section 270500, Common Work Results for Communications, applies to this Section.

1.3 QUALITY ASSURANCE

- A. Identification and administration work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA- 606-B Administration Standards.
 - 2. ANSI/TIA-569-B Pathway and Spaces
 - 3. ANSI/TIA-568-C Telecommunications Cabling Standard.
 - 4. BICSI Telecommunications Distribution Methods Manual.
 - 5. UL 969.

1.4 SUMMARY

- A. Voice Communications Equipment
 - 1. Voice Communications Equipment includes customer-owned phones, faxes, etc., required to connect the Dining Hall to the rest of the campus and the public switched telephone network (PSTN).
 - 2. The owner provides Voice Communications Equipment at UNT.
 - 3. Voice Communications Equipment will be owner-furnished and owner-installed (OFOI).

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 COORDINATION

- A. Cable Contractor shall fully coordinate with the Owner's Voice Communications Equipment provider as required to ensure proper integration and connectivity between systems.
- B. Cable Contractor shall furnish a labeled floor plan and Excel run sheet to the Owner's Voice Communications Equipment provider two weeks prior to occupancy.
- C. Cable Contractor shall furnish and install all patch cords in conjunction with the Owner's Voice Communications Equipment provider.
- D. Cable Contractor shall provide adequate technician support when the Owner's Voice Communications Equipment provider is planning and installing new voice and data equipment installation and connectivity.
- E. Cable Contractor shall provide adequate technical support on the first business day after the installation and connectivity of voice equipment.

END OF SECTION 273000

SECTION 274000 - AUDIOVISUAL SYSTEMS

PART 1 GENERAL

1.1 DEFINITIONS

- A. Owner: University of North Texas (UNT)
- B. Project: Kerr Hall Interior Renovation
- C. Architect: TreanorHL
- D. Consultant: 4b Technology Group
- E. Contractor: Contractor or subcontractor providing and installing the audiovisual system
- F. GC: General Contractor
- G. OFE: Owner Furnished Equipment
- H. OFOI: Owner Furnished Owner Installed
- I. OFCI: Owner Furnished Contractor Installed
- J. CFCl: Contractor Furnished Contractor Installed

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. Section includes furnishing, installing, testing, and documenting the audiovisual system for digital signage systems along with executive office, huddle room, team room and community/living room locations in the Owner's Project.
- B. General elements of the work will consist of (but are not limited to) the following:
 - 1. Procuring all permits and licenses required by local governing bodies for complete and functional audiovisual system installation.
 - 2. Attending pre-construction/pre-submittal meetings with Owner and Consultant to review design package for the audiovisual system.
 - 3. Providing continuous on-site supervision of installation technicians.
 - a. On-site supervision will include daily oversight of work, updating worksite progress drawings to reflect changes and installations details, preparing weekly progress reports, and attending on-site coordination meetings as directed by the Owner and Consultant
 - 4. Providing equipment, labor, materials, tools, appliances, and transportation required for a complete and functional audiovisual system as described within the design specifications and drawings.
 - 5. Providing all miscellaneous hardware including (but not limited to) cable management devices, termination cabinets, cable labeling materials, fasteners, hangers, and brackets required for complete and functional audiovisual system installation.
 - 6. Providing all required audiovisual system software and licenses to the Owner.
 - 7. Coordinating with all trades and Owner representatives as required to facilitate the installation of control systems equipment including (but not limited to) door hardware, fire alarms, blinds, shades, HVAC, and electrical divisions.
 - 8. Coordinating and documenting receipt of Owner furnished equipment.
 - 9. Protecting new facilities finishes and equipment.
 - 10. Maintaining construction materials and refuse within the area of work on-site.
 - 11. Cleaning the work area on-site at the end of each day and disposing of waste in designated refuse bins or containers.
 - 12. Coordinating network settings, configurations, and requirements in conformance to owner standards (i.e. isolated AV network, AV VLAN, etc.) to ensure proper function of the audiovisual system equipment.

- C. The work described in these specifications and drawings have been provided to meet certain performance requirements.
 - 1. Some information such as exact equipment models, layout, wire routing, conduit pathway, power requirements, etc. has been omitted.
 - 2. The audiovisual system is designed to efficiently support the Owner's various facilities and activity areas in a manner which can be reasonably and proficiently managed by the staff.
 - 3. Contractor is responsible for translating these specifications and drawings into a complete design package containing all the necessary elements to deliver a complete turnkey installation including (but not limited to) all materials, labor, warranties, shipping and permits.
 - a. In the event of any conflicts between design specifications and drawings, the Contractor will provide written notification to Consultant of any such occurrences before purchasing any equipment or materials and performing any installation services.
 - i. The Consultant will notify the Contractor of any actions required to resolve these conflicts which may include (but not be limited to) design changes, equipment, materials and/or installation changes.
 - ii. In any event, Contractor will not supersede specifications and standards from the latest NFPA and NEC publications.
- D. In all cases, the Contractor is solely responsible for the performance of the audiovisual system and the delivery of complete system documentation for each part of the Project.

1.4 ROOM TYPE FUNCTIONAL NARRATIVES

- A. Background Music System
 - 1. This system will support sound reinforcement of audio content from an owner furnished media player and paging override for an owner furnished microphone.
 - a. An array of distributed ceiling speakers will provide sound reinforcement of audio content throughout the Dining area.
 - b. A wall mounted equipment rack will house and manage all audio system devices (media player, digital signal processor, audio amplifier, etc.).
 - c. A button/knob control interface located inside the wall mounted equipment rack will provide volume up/down control of the distributed loudspeaker system.
 - d. A desktop gooseneck microphone will be located at an administrator's desk for paging override of the background music system.

1.5 PROGRAMMING

- A. Coordinate and provide programming review meeting(s) with Owner to address and advise on control system capabilities (per room type) based on Project drawings and specifications.
- B. Deliver control system and digital signal processor programming source code configuration files (both compiled and uncompiled per room type) to the Owner as a requirement for final acceptance of the audiovisual system.
- C. Provide programming labor to cover audiovisual system functional control changes and modifications requested by the Owner within the warranty period beginning after the final acceptance date.
- D. Refer to 1.8 – SUBMITTALS later in this document for additional requirements.

1.6 BID RESPONSE

- A. Provide a bid response document with line-item pricing that is formatted and organized to identify unique room types, locations, and/or general systems along with the total installation cost associated for each.
- B. Line-item pricing per room type, location, or general system will include (but is not limited to) equipment, accessories, software, hardware, subscriptions, licenses, labor types, general, administrative, and miscellaneous costs required for installation of a functional audiovisual system.

1. The provided equipment list should contain line-item manufacturer, model, quantity, unit cost and extended cost information for each component in that specific room type, location, or general system.
2. Installation labor per room type, location, or general system should be presented separately from the associated equipment list with line-item pricing.
3. General, administrative, and miscellaneous equipment or labor costs including (but not limited to) design, drawing production, programming, project management, shipping, handling, and training per room type, location or general system should also be presented separately with line-item pricing for each category.
4. Please see the following example for Bid Response Pricing Data submittal package formatting guidance:

Sample Bid Response Pricing Data

Room Type	Manufacturer	Model	Qty.	Unit Cost	Ext. Cost
Huddle Room	Product	A	1	1.00	1.00
	Product	B	2	1.00	2.00
	Contractor	Install Labor	1 hr.	1.00	1.00
	Contractor	Programming	2 hr.	1.00	2.00
	Contractor	Project Management	3 hr.	1.00	3.00
	Contractor	Training	1 hr.	1.00	1.00
	Contractor	Shipping	N/A	1.00	1.00
	Contractor	Miscellaneous	N/A	1.00	1.00
				SUBTOTAL	12.00
Conference Room	Product	A	1	1.00	1.00
	Product	B	2	1.00	2.00
	Product	C	1	1.00	1.00
	Contractor	Install Labor	2 hr.	1.00	2.00
	Contractor	Programming	3 hr.	1.00	3.00
	Contractor	Project Management	4 hr.	1.00	4.00
	Contractor	Training	2 hr.	1.00	2.00
	Contractor	Shipping	N/A	2.00	2.00
Contractor	Miscellaneous	N/A	2.00	2.00	
				SUBTOTAL	19.00
				TOTAL	31.00

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Contractor will have a minimum of five years' experience installing, programming, and commissioning audiovisual systems of a comparable size and scope.
2. Contractor's project installation team will feature at least one individual with an active Certified Technology Specialist – Installer (CTS-I) designation to supervise and approve all on-site work.
3. Contractor's project installation team will feature a dedicated Project Manager whose responsibilities include (but are not limited to) the oversight of system programming, operations and maintenance manual preparation, training coordination, testing protocols, testing documentation, document deliverables, and labor scheduling.
4. Contractor's project installation team members must demonstrate knowledge and compliance with all AVIXA, TIA, UL, and NEC methods, standards, and codes.
5. Contractor's project installation team must be certified by industry groups and/or equipment manufacturers relevant to this project's scope of work and bill of materials as

- having completed the training necessary to perform their specific installation task(s).
6. Owner's representative(s) may make such investigations (as deemed necessary) to determine that the Contractor is responsive, responsible, and qualified to execute the work outlined by the Contract.
 - a. In this regard, the Contractor will furnish to the Owner such information as requested for this purpose.
 - b. Information and data may include (but not necessarily be limited to) the date of organization and/or incorporation, number of years engaged in this business under present firm's name, a list of major equipment owned by the company, a list of principal personnel who will be involved in the execution of this contract along with the experience and qualifications of each person.
 7. Contractor will be an authorized manufacturer's representative for all products which they install.
 8. Contractor will have in-house engineering and project management staff with capabilities to satisfy the requirements of the Project and located no more than one hundred miles away from the Owner's site.
 9. Contractor will have a consistent presence (or subcontractor organization) located no more than one hundred miles away from the Owner's site that can provide maintenance and services for the for the audiovisual system during the required (or optional extended) warranty period.
 10. Contractor will be capable of providing emergency maintenance and service twenty-four hours per day, seven days per week.
- B. The Contractor will provide all materials, equipment, and installation in compliance with the latest applicable standards from ANSI, ASTM, AVIXA, FCC, IEEE, NCTA, NEC, NEMA, NFPA, REA, TIA/EIA, and UL including (but not limited to):
1. American National Standards Institute (ANSI)
 2. ANSI T1.404 (DS3) and CATV Applications
 3. American Society for Testing and Materials (ASTM)
 4. American with Disabilities Act (ADA)
 5. EIA/TIA-569 Standard, Commercial Building Standard for Telecommunications Pathways and Spaces
 6. EIA/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
 7. National Cable Television Association (NCTA)
 8. NCTA-02 NCTA Recommended Practices for Measurements on Cable Television Systems
 9. National Electrical Code (NEC) (latest revision and pertinent addendums)
 10. Article 250, Grounding
 11. Article 300, Part A. Wiring Method
 12. Article 310, Conductors for General Wiring
 13. Article 800, Communication Systems
 14. National Fire Protection Association (NFPA) Publications (latest revisions and pertinent addendums)
 15. Underwriters Laboratories (UL)
 16. NECA 1 Good Workmanship in Electrical Contracting
- C. Electrical Components, Devices and Accessories:
1. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

1.8 SUBMITTALS

- A. Contractor's CTS-I supervisor will review, approve, and sign off on all submittal documents.
- B. Provide evidence of compliance with specifications described in 1.7 - QUALITY ASSURANCE as requested by the Owner and/or Consultant.
- C. Partial submittals will not be acceptable without prior approval in writing from the Consultant.
- D. Until the Consultant approves the full submittals, the Contractor will not commence any work,

nor will the Contractor order any equipment related to the audiovisual system.

- E. Approval of submittals does not relieve the Contractor from any contract-required responsibilities.
- F. Product Data
 - 1. Provide cut sheets for each component within in a unique room type, room location, and/or general system and include notes on the cut sheet identifying specific models, color finishes, accessories, or relevant selection details (when multiple options are shown in any category) for that equipment.
 - 2. Organize cut sheets into a single .pdf package with an index on the first page which specifies the following information:
 - a. Room type, room location, and/or general system name
 - b. Equipment manufacturer and model name of each component within that room type, room location, and/or general system
 - c. Color option availability of each equipment component
 - d. Color selection specification of each component per room type, room location and/or general system name (where applicable)
 - e. Page number location within the submittal package for the first cut sheet of each component.
 - 3. When custom equipment (podium, lectern, in-room rack, etc.) is specified for the Project that features multiple selection options (finishes, accessories, logos, etc.), the Contractor will provide a completed version of the manufacturer's configuration document and/or a copy of the manufacturer's unique quote featuring all customized selections within the Product Data submittal package.
 - a. Coordination meeting(s) between the Contractor and Architect may be required to review and advise on custom equipment configuration options based on Project drawings and specifications.
 - 4. The following example shows the minimum information required for review of Contractor's Product Data submittal package:

Sample Index

Room Type	Color Option	Color Selection	Page #
Huddle Room			
- Product A	✓	White	2
- Product B	x	N/A	3
Conference Room			
- Product A	✓	Black	2
- Product B	x	N/A	3
- Product C	✓	Custom	4
			Page 1

Sample Product Data

<u>Product A</u>
Cut Sheet
Page 2

Sample Product Data

<u>Product B</u>
Cut Sheet
Page 3

Sample Product Data

<u>Product C</u>
Custom Configuration Document or Manufacturer's Custom Quote
Page 4

G. Programming

1. Provide screenshots, templates, and functional examples of all graphic user interface design which will be displayed on audiovisual system control equipment including (but not limited to) touch panels, button panels, and web or desktop applications for sign off and approval by the Owner.
 - a. Contractor must obtain written approval from Owner for all graphic user interface design and functionality (per room type) prior to deployment of audiovisual system programming.
 - b. Without written approval, Owner reserves the right to reject graphic user interface design and/or functionality and require specific updates to satisfy their programming requirements.

H. Shop Drawings

1. Contractor's on-site supervisor will review, approve, and sign off on all shop drawings, coordination drawings and as-built drawings.
2. The contract design documents (including but not limited to floor plans, reflected ceiling plans, wiring schematics, elevations, details, or section drawings) will not be accepted as submittals and do not relieve the Contractor from the obligation to produce and provide their own shop drawings.
3. Shop drawings to include the following:
 - a. Drawing legend sheet identifying and describing all symbols used on the Contractor's documents
 - b. Floor plans and reflected ceiling plans showing all audiovisual system equipment with wiring pathways represented
 - c. Dimensioned elevations and sections showing wall, ceiling and/or surface mounted audiovisual system equipment

- d. Details showing mounting and installation specifications for audiovisual system equipment.
 - e. Schematic block diagrams for each audiovisual room type featuring equipment manufacturer and model information with connector level details for all system components including (but not limited to) audio, video, control, and power signals
 - f. Elevations for all equipment racks including (but not limited to) ceiling enclosures, wall enclosures, lecterns, and teaching consoles
 - g. Cable runs with tags for type, gauge, quantities, and cable identifiers
 - h. System riser diagram indicating all field devices, riser paths and room designations as required.
 - i. Fabrication shop drawing(s) showing component layout and location of custom configured equipment (cable cubby, podium, lectern, etc.) for approval by the Owner.
- I. Samples
1. As requested, provide samples to the Owner and/or Architect for audiovisual system equipment color and texture finish coordination.
- J. Resubmitting
1. If any submittal documents are rejected by the Consultant, the Contractor will be responsible for making the required corrections or changes identified by the Consultant's stamp instructions and attached comments.
 - a. Contractor will clearly identify corrections or changes on resubmitted documentation by clouding areas which have been updated.
 - b. Consultant will only review clouded areas of correction or change within resubmitted documentation.
 2. Contractor will be responsible for project delays caused by rejected submittals.
 3. If both the Contractor's original submittals and resubmittals are each rejected, then the Consultant will be compensated for the additional services required to review the third (and any subsequent) Contractor submittal documents.
 - a. The amount of such compensation will be incorporated via change order and withheld from the Contractor application for payment.

1.9 ENVIRONMENTAL CONDITIONS

- A. Audiovisual system components will be rated for the environments where they are proposed to be installed.
- B. Manufacturer environmental (temperature, humidity, etc.) ratings and requirements will be followed exactly to ensure reliable equipment operation and maintain warranty coverage.
- C. Contractor will be responsible for verifying that the environmental conditions of the proposed audiovisual system equipment installation location does not exceed the minimum/maximum ratings and requirements of the specified audiovisual system components.
- D. The following are environmental control requirements for interior equipment spaces as described in the BICSI Telecommunications Distribution Methods Manual (TDMM), 13th Edition:
 1. Temperature: $\approx 18^{\circ}\text{C}$ to $\approx 27^{\circ}\text{C}$ ($\approx 64^{\circ}\text{C}$ to $\approx 81^{\circ}\text{F}$)
 2. Relative humidity: 60%
 3. Heat dissipation: ≈ 751 to ≈ 5016 BTU (220 to 1470 watt-hours) per cabinet

1.10 PROJECT COORDINATION PLAN

- A. Contractor will submit a project plan to the General Contractor detailing the steps and associated timeframe to meet the Project's schedule requirements. Project plan should include benchmarks for items such as regular project meetings, equipment ordering, delivery, installations, configuration, calibration, testing, burn-in, training, substantial completion notification, final testing, and final acceptance.
- B. Contractor assumes responsibility for coordinating with building trades or other parties that may be identified by the General Contractor to ensure functional delivery of the audiovisual system.

- C. Contractor will coordinate size and location of conduit systems, back boxes, and provisions for electrical power to specified audiovisual system equipment.
- D. Contractor will obtain written permission from the General Contractor prior to routing and/or installing cable, equipment, or service through the facility.
- E. Contractor will prepare the installation schedule to coordinate sequencing, dependencies, and priorities of the audiovisual system installation including work by other trades.

PART 2 PRODUCT

2.1 APPROVED MANUFACTURERS & ALTERNATES

- A. The following product specifications (along with those detailed on the project drawings) are presented as a basis of design in order to set minimum levels of acceptable equipment performance and functionality standard.
- B. Contractor may make equipment substitutions for alternate manufacturers and/or models so long as they meet or exceed the performance and functional standard set forth in the basis of design.
- C. Should Contractor make substitutions for alternate manufacturers and/or models, Contractor must provide to Consultant the following:
 - 1. A comprehensive list documenting the originally specified equipment and the make/model of equipment which is being proposed as an alternate.
 - 2. Notation on the Product Data submittal package identifying which equipment therein is an alternate and what originally specified equipment it is being substituted for.

2.2 CABLE

- A. Where applicable, Provide white cable for all audiovisual horizontal cabling.
 - 1. Refer to Telecom specification to avoid cable color conflict.
- B. 70 Volt Speaker Cable
 - 1. Minimum 16 AWG, twisted, stranded CL2/CL2P unless otherwise noted schematically.
- C. Low Impedance Speaker Cable
 - 1. Minimum 12 AWG, twisted, stranded CL2/CL2P unless otherwise noted schematically.
- D. Microphone Level Cable
 - 1. Minimum 22 AWG, with 22 AWG drain wire, shielded, twisted, stranded CL2/CL2P unless otherwise noted schematically.
- E. Line Level Cable
 - 1. Minimum 22 AWG, with 22 AWG drain wire, shielded, twisted, stranded CL2/CL2P unless otherwise noted schematically.
- F. Low Voltage Control Cable
 - 1. Minimum 18 AWG twisted, stranded CL2/CL2P unless otherwise noted schematically.
- G. Category cable
 - 1. Cat6A UTP for isolated audiovisual networks.
 - 2. For cables connected to the Owner's network, refer to Telecom specifications.
- H. HDBaseT/Crestron DM/Extron XTP – Manufacturer's recommendation for maximum available resolution, frame rate, color sampling, color depth and distance of connected hardware.
- I. Minimum acceptable audiovisual system systems wiring performance standards will be as follows:
 - 1. Speaker cable - Per ANSI WC57 standard test.
 - 2. CAT6 - Per ANSI/TIA/EIA-568-8.1 standard test.
 - 3. Fiber optic cable - Per ANSI/TIA/EIA-568-B standard test.
 - 4. RS 232 - Per ANSI/ WC66 standard test.
 - 5. Line level shielded audio cable - Per ANSI WC66 standard test.
 - 6. Microphone level shielded audio cable - Per ANSI WC66 standard test.
 - 7. Video coaxial cable - Per ANSI/TIA/EIA-TSB-67 standard test.
 - 8. Multi-conductor control cable - Per ANSI WC57 standard test.

2.3 AUDIOVISUAL PATHWAY

- A. Install j-hooks or saddlebags four to five feet apart. Avoid uniform spacing to minimize problems with signal degradation.
- B. Support j-hooks or saddlebags from decking or building structure using methods approved by the manufacturer.
- C. Cable count will not exceed manufacturer's recommended maximum. Add separate parallel j-hook pathway when cable count requires it.

2.4 AUDIOVISUAL PATCH CABLES

- A. Provide audiovisual patch cables for all audiovisual plates and interconnectivity locations.
- B. Minimum 6' patch cables for device interconnect cabling.
- C. Minimum 12' patch cables for user interface connection.
- D. Approved manufacturers:
 - 1. Extron
 - 2. Crestron
 - 3. Cables To Go (Premium)
 - 4. Or approved equal

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor will be responsible for providing all wire and cable as required for complete and functional audiovisual system operation.
- B. All cables must be continuous runs from the device location to the ultimate point of termination. Mid-run cable splices or couplers are not acceptable.
- C. Make cable connections with solderless devices that are mechanically and electrically secure in accordance with manufacturer's recommendations.
- D. Installation techniques which may degrade the mechanical and communications characteristics of audiovisual system cables are *not* acceptable.
- E. The Contractor will not place audiovisual system wiring in the same conduit or raceway with wire for electrical power distribution.
- F. Wiring Method
 - 1. Cable distribution will be accomplished using cable trays, j-hooks, cable runways, conduit raceways, ducts, core holes, extended columns, false half-columns, and plenums.
 - 2. Install cables in raceways in all locations as indicated in the design specifications and drawings excluding (but not limited to) accessible indoor ceiling spaces and hollow gypsum-board partitions.
 - 3. Conceal all raceways and associated wiring as indicated in the design specifications and drawings excluding (but not limited to) unfinished spaces
 - 4. Horizontal cable segments will be supported by distribution rings when cables enter and exit cable trays.
 - 5. Cables will be supported by cable runways and distribution rings when they converge at equipment room locations
 - 6. All cable placements will be based on design specifications and drawings.
- G. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bend radius.
 - a. Provide and use lacing bars and distribution spools where necessary to accomplish the above requirements.
- H. Splices, Taps and Terminations
 - 1. For power and control wiring, use numbered terminal strips in junction, pull boxes, outlet boxes, terminal cabinets, and equipment enclosures.

2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
 - a. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- I. Grounding & Bonding
 1. The Division 26 contractor will be responsible for providing the required grounding means for all audiovisual system equipment per the NFPA 70, National Electrical Code (latest adopted edition), additional applicable codes, laws, or regulations from federal, state, and local AHJs, the direction from the licensed electrical engineer of record for the Project, and from the audiovisual manufacturer's recommendations.
 2. Contractor will be responsible for ensuring ground continuity by properly bonding all appropriate audiovisual cabling, closures, cabinets, service boxes and framework to the main building grounding electrode system.
 - a. All bonding connections will consist of minimum 12 AWG copper wire and will be bonded to the approved main electrical ground for the building.
 - b. Contractor will coordinate with electrical engineer of record for the Project to ensure the proper grounding and bonding is completed for the audiovisual system.

3.2 CONSTRUCTION MEETINGS

- A. The Consultant and/or Owner will hold regular construction meetings to review the installation schedule. It is mandatory that the Contractor's Project Manager attend each meeting.

3.3 SITE INSPECTION

- A. Continuously verify that the site conditions agree with the Contract Documents and the audiovisual system design. Notify Owner's representative immediately of conditions that effect the performance of the installed system.
- B. Identify and coordinate any required work that is not specified in the Contract Documents.
- C. Identify and coordinate any special environmental conditions for equipment installation that is not specified in the Contract Documents.

3.4 COORDINATION

- A. Verify adequate conduit, back boxes and power have been provided for the audiovisual system installation.
 1. Notify General Contractor immediately of discrepancies and/or deficiencies identified in any of these categories.

3.5 IDENTIFICATION, LABELING AND DOCUMENTATION

- A. Equipment Identifications
 1. The Contractor will label all termination devices, panels, enclosures, and equipment rooms.
 2. The Contractor will mark each unit with permanently attached markings that will not impair the equipment or present a hazard to maintenance personnel.
- B. Cable Labeling
 1. Place wire identification numbers $\frac{1}{4}$ " on each end of all conductors and or connectors by using sleeve-type heat shrinkable markers.
 2. Install markers to be readable from left to right or top to bottom.
 3. Wire numbers will be computer printed (Brady TLS2200 with Permasleeve cable marking labels or equivalent). Hand-written labels are not acceptable.
 4. Mark all spare conductors.
- C. Project Documentation

1. The Contractor will establish and maintain complete system documentation including (but not limited to) the following:
 - a. Floor plan and reflected ceiling drawings that indicate device locations, conduit locations, junction box locations and wire routing pathways
 - b. Mounting details for all equipment and hardware
 - c. Functional block diagrams for each room type with cable type identification
 - d. Rack elevations
2. Contractor to maintain a progress set of design documents which will be updated daily to reflect the current condition of the work and made available for review by the Consultant and Owner upon request.
3. If audiovisual system changes occur prior to acceptance testing which alters the previously furnished documentation, the Contractor will formally update and reissue the relevant documentation to the Consultant and Owner.
4. Consultant and Owner may review all documentation for accuracy and completeness and may reject substandard submittals.

3.6 FIELD QUALITY CONTROL

- A. Inspection
 1. Verify that units and controls are installed, connected, and labeled in accordance with the design specifications and drawings.
 2. Verify that interconnecting wires and terminals are identified in accordance with the design specifications and drawings.
- B. Pre-testing
 1. Verify that audiovisual system components function in compliance with the design specifications and drawings with equipment, wiring and control functionality adjustments made, as necessary.
- C. Test Schedule
 1. Provide a minimum of ten days' notice of test schedule to Owner.
 - a. Contractor will schedule testing with the Owner after normal and functional audiovisual system operation has been observed for a period no less than fourteen days after pre-testing.
- D. Operational Tests
 1. Perform operational system tests for each room type to verify that audiovisual system complies with design specifications and drawings.
 2. Include all modes of system operation during testing procedures.
 3. Evaluate each component for proper operation in all functional modes.
 4. Record test results for each room type and piece of equipment.
 5. Remove and replace malfunctioning items and retest as specified above.
- E. Re-test:
 1. Correct deficiencies identified or observed during the testing process and re-test until specified requirements are met.

3.7 SPEAKER SYSTEM CONFIGURATION

- A. Equalize speaker systems flat from 80 Hz to 2 KHz.
- B. Program speaker systems with a high pass filter at 60Hz with 12dB per octave roll-off and a low pass filter 15 KHz with 12 dB per octave roll-off.
- C. The Contractor will provide calibration of speaker systems using sound analyzing software/hardware (SmaartLive, TEF SoundLab, Meyer's SIM or equivalent), a suitable calibration microphone, and a trained operator capable of making (or recommending) appropriate system adjustments including (but not limited to) delay timing, cabinet aim and equalization.
- D. Use a minimum of three measurement locations in the speaker systems intended coverage area to calibrate the system response.
- E. The Contractor will coordinate speaker testing and calibration with the expectation that this

work will take a minimum of one hour per room type.

1. The Contractor will be responsible for coordinating with the Owner to ensure that the working environment will be quiet room during speaker testing and calibration times.
- F. Contractor to record all speaker system measurements, settings, and adjustment for inclusion in the operations and maintenance manuals.

3.8 TRAINING

- A. Contractor will provide competent instruction personnel to train the Owner's general, operations, facilities, maintenance and/or technical support staff on topics including (but not limited to) location, operation and troubleshooting of the installed systems.
- B. Contractor to produce a custom, quick reference guide per room type with the most inexperienced audiovisual system user as the intended audience.
1. Provide one laminated hard copy for each room location as part of the final documentation package.
 2. Provide one digital copy of the quick reference guide for each room type as part of the final documentation package.
- C. Contractor will develop separate training plans with "general users" (low audiovisual technology comprehension) and "power users" (high audiovisual technology comprehension) as the intended audience.
1. "General user" training will minimally consist of:
 - a. Two independent sessions, each one-hour in duration per room type.
 - b. Printed reference material for each attending trainee (written in plain language) addressing normal day-to-day operations, selectable control system features, and basic system block diagrams.
 - c. Review of the quick reference guide per room type.
 - d. Demonstration of control system functionality per room type.
 - e. Question and answer session.
 2. "Power user" training will minimally consist of:
 - a. Two independent sessions, each one-hour in duration per room type.
 - b. Detailed explanation of audiovisual system components and functionality per room type empowering trainees to analyze potential malfunctions, troubleshoot issues and recommend modifications or additions.
 - c. Printed reference material for each attending trainee (written in plain language) addressing technical operation, adjustment, and programming, system features, system block diagrams, and as-built drawings.
 - d. Review of the quick reference guide per room type.
 - e. Demonstration of control system functionality per room type.
 - f. Question and answer session.
- D. Training sessions to be scheduled in coordinated with the Owner after approval of formal training plans and occurring no more than six months after substantial completion.
1. Complete operations and maintenance manuals and preliminary as-built drawings will be delivered to the Owner one week prior to the first scheduled training session.

3.9 WARRANTY

- A. The Contractor will warrant the system for parts and labor for one year.
1. Warranty commences at the time of substantial project completion acceptance by Owner.
 2. Nothing will be construed to limit this obligation to a shorter period.
- B. Warranty service will be rendered on-site at the request of Owner to repair or replace any defective materials, equipment and/or workmanship without cost to the Owner unless the Owner has previously given the Contractor a written acceptance of such condition.
1. The Owner will give prompt notice of the defect(s) either verbally or in writing to Contractor.
- C. Once every six months following the of date of substantial completion, the Contractor will provide on-site maintenance to make adjustments which suit actual occupied conditions and

- optimize performance of the installed equipment including (but not limited to):
1. Inspecting of all components for proper operation and installation
 2. Cleaning of equipment that features an air intake, filter, or fan
 3. Checking and testing cable connections/terminations
 4. Analyzing control system presets and graphic user interface design based on feedback from Owner
 5. Recommend changes to the audiovisual system to improve Owner's utilization of the system
- D. Contractor will coordinate with the Owner to schedule the performance of required six-month on-site maintenance and include confirmation of that scheduling coordination as part of the Project close out documentation.
- E. Contractor will coordinate with the Owner on scheduling service technicians (who will check in and check out with Owner at the beginning and end of each visit) to perform maintenance/warranty work.
- F. Within two business days after the completion of the on-site maintenance/warranty service, the Contractor will provide the Owner a written report including (but not limited to) work performed, equipment repaired or replaced, and recommended audiovisual system updates or modifications.
- G. In the event of an equipment failure which cannot be repaired on-site, the Contractor will make a reasonable effort to provide the Owner with temporary equipment to maintain audiovisual system functionality.
- H. General Repair or Replacement Service
1. Repair or replacement service during the warranty period will be performed five days a week and during Contractor's normal business hours with a four-hour response time.
 2. If the Contractor cannot restore system operation during the warranty period within two business days of the system failure, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.
- I. Emergency Repair or Replacement Service
1. Provide the Owner optional repair or replacement service pricing for emergency level work to be performed seven days a week and twenty hours a day with a one-hour response time as part of the Bid Response package.
- J. Extended Audiovisual System Support
1. Provide the Owner optional extended service agreement pricing, terms, and conditions to support and maintain the audiovisual system during years two through five after the final acceptance date as part of the Bid Response package.

3.10 SUBSTANTIAL COMPLETION

- A. Work must meet the following requirements to qualify for the Owner's consideration of Substantial Completion:
1. All audiovisual system devices will be completely installed, powered, online and operational.
 2. All sub-system interfaces must be complete and operational.
 3. Initial training schedule submitted.
 4. Owner may utilize the system for its designed intent.
- B. Contractor will provide a list of remaining work items and approximate completion date(s).
- C. Contractor will certify in writing that all remaining work is minor in nature and will be completed in less than thirty days.

3.11 TESTING REQUIREMENTS

- A. Audio Performance
1. Harmonic Distortion
 - a. Measure the total harmonic distortion of the audio system. The distortion level should not exceed industry best practices, result in an audible hiss, or create audible noise at any system gain level.

2. Signal-to-Noise
 - a. Measure the signal-to-noise ratio of the audio system. The noise level should not exceed industry best practices, result in an audible hiss, or create audible noise at any system gain level.
3. Frequency Response
 - a. Measure the system's frequency response for speech sound reinforcement, which should be determined during design. Also measure frequency response for program sound amplification.
4. Speaker Polarity
 - a. Program loudspeakers in the same system should produce consistent polarity for a mono input signal in all channels. Speech reinforcement systems should be polarized so that positive acoustic pressure on a microphone will result in positive acoustic pressure at all loudspeakers.
5. Multiple Sources
 - a. Calibrate audio system inputs so that there is zero or minimal difference between any input signal level.
6. Conferencing Systems
 - a. When working on a conferencing system, adjust the microphone input gain to demonstrate that a standard talker, positioned at each talker position in the room, produces a dBu level of zero at the output bus of the digital signal processor. Verify signal levels for both transmitting and receiving normal speech.
7. Amplifier Loads
 - a. Make sure no power amplifier exceeds its rated load. Record the impedance (and at what frequency) for each loudspeaker line of each power amp. If available, 63, 250, and 1,000 Hz are recommended.
- B. Video Performance
 1. NTSC Signal Gain
 - a. For NTSC sources, you should demonstrate that a consistent, 1-volt, peak-to-peak test signal at each source produces a 1-volt, peak-to-peak to each destination. Verify at each destination using NTSC bars, peak white, and five-step multiburst.
 2. Projected Displays
 - a. Verify that projected displays are focused, centered, and evenly illuminated. Using a light meter, make sure a projected image has uniform brightness across the whole image, and measure the contrast ratio with ambient lighting in normal operating mode.
 3. Multiple Resolutions
 - a. The video system should be able to display stable, properly scaled images with no artifacts when switching among, at minimum, 720p, 1080i, and 1080p sources, plus all sources in the performance criteria.
- C. The Contractor will perform sample tests in the presence of the Consultant and Owner.
 1. All testing will comply with EIA/TIA Standards and that of the equipment manufacturers.
 2. Performing the testing procedures specified herein assures that the communications cabling and system electronics meets the specified performance characteristics.
 3. If testing indicates that the performance characteristics are not met, the test will be considered "failed" and any other test that may be affected by the modification and/or repair will be re-run and verified.
- D. The Contractor will provide testing equipment to certify 100% operational condition of all audiovisual system cabling, components, and programming.
- E. The Contractor will prepare and submit all test procedures, forms and results to the Owner and Consultant.
 1. The test procedures will have Owner and Consultant approval before the testing begins.

3.12 SYSTEM CHECK-OUT AND VERIFICATION

- A. Verify continuity of cabling between field devices and controllers.
- B. Commission all devices from field to front end.
- C. Contractor supplied "As-Built" Drawings will show conduit routing.

- D. Review all As-Built documentation and Operation and Maintenance manuals with Owner.
 - 1. Revise and reissue as required.
- E. Provide As-Built/Record Drawing documentation in PDF and AutoCAD formats.
- F. Demonstrate proper sequences of operation for all devices.

3.13 FINAL ACCEPTANCE OF SYSTEMS

- A. Each area of construction submitted as "complete" will meet the following criteria under testing:
 - 1. System must meet all specifications as described in these instructions.
 - 2. Operational prints, manuals, signal logs and As-Built prints must be furnished.
 - 3. Visual testing and signal verification will be conducted at random locations to determine that equipment performs satisfactorily.
- B. Specifications set forth for construction of the system have been produced to ensure system compatibility and performance.
 - 1. Compliance to these specifications will be determined during periodic observances of construction.
 - 2. Repeated failure to comply with the specifications will be considered before the acceptance phase of the Project commences.
- C. Within ten days receipt of the final acceptance notice, the Owner's representatives will schedule and perform the final inspection.
 - 1. Declaration that the Project is "complete" will be achieved when the work is found acceptable under the contract documents and that the contract has been fully performed.

END OF SECTION 27 4100

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. 280500 Electronic Safety and Security
- B. 281300 Access Control
- C. 282300 Video Surveillance

1.2 DESCRIPTION

- A. This Section, Requirements for Electronic Safety and Security Installations, applies to all sections of Division 28.
- B. Furnish and install electronic safety and security cabling, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of cable and other items and arrangements for the specified items are shown on drawings.

1.3 REFERENCE STANDARDS

- A. Adherence to and compliance with the codes and standards referenced and the UNT, unique requirements, and design solutions is mandatory. Requests to deviate from the industry standards and design solutions prescribed in these guidelines may be submitted on a case-by-case basis in accordance with the instructions in the Policy and Procedures section of these guidelines. No deviation from the requirements of the National Electrical Code (NEC) will be allowed.

1.4 CODES, STANDARDS, REFERENCES, AND APPLICABILITY

- A. National Electrical Code, NFPA 70.
 - 1. The National Fire Protection Association has acted as the sponsor of the National Electrical Code (NEC) since 1911. The original Code was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests. The purpose of the NEC is the practical safeguarding of persons and property from hazards arising from the use of electricity. The NEC provides the minimum code requirements for electrical safety. In security distribution design, the NEC must be used in concert with the ANSI/EIA/TIA standards identified below, which are intended to ensure the performance of the security infrastructure.
- B. TIA Standards
 - 1. The Telecommunications Industry Association (TIA) engineering standards and publications are designed to serve the public interest by eliminating misunderstandings between manufacturers and purchasers. The standards facilitate the interchangeability and improvement of products and assist the purchaser in selecting and obtaining the proper product for his or her particular need.
- C. Cabling Standard, ANSI/TIA-568-C (SERIES)
 - 1. The ANSI/TIA-568-C (series) is the Commercial Building Cabling Standard. This standard defines a generic security wiring system for commercial buildings supporting a multi-product, multi-vendor environment. It also provides direction for the design of security cabling products for commercial enterprises.
 - a. The purpose of the standard is to enable the planning and installation of building wiring with little knowledge of the security products that subsequently will be installed. Installation of wiring systems during building construction or renovation is significantly less expensive and less disruptive than after the building is occupied. ANSI/TIA-568-C establishes performance and technical criteria for various wiring system configurations for interfacing and connecting their respective elements.
- D. Pathways and Spaces, ANSI/TIA-569-C (SERIES).
 - 1. The ANSI/TIA-569-C (series) is the Commercial Building Standard for Pathways and Spaces. This standard will be followed at the UNT and recognizes three fundamental concepts:
 - a. Buildings are dynamic. Over the life of a building or campus, remodeling is more of a rule than an exception. The standard recognizes that changes will take place.
 - b. Building security systems and media are dynamic. Security equipment and cabling change dramatically over the life of a building or campus. The standard recognizes this fact by being as independent as possible from specific vendor equipment and media.

- c. Security is more than just locks and cameras. Security encompasses many building systems, including environmental controls, fire alarms, and emergency paging.
 - d. To have a building or campus successfully designed, constructed, and provisioned for Security, the security design must be incorporated during the preliminary architectural design phase. The architect must work closely with the designated Security & IT staff members to accomplish this.
- E. Grounding and Bonding, ANSI-J-STD-607-B (SERIES)
- 1. The ANSI/TIA-607-B (series) (also known as ANSI J-STD-607-B) is the Commercial Building Grounding and Bonding Requirements for Security. The National Electrical Code (NEC) provides grounding, bonding, and electrical protection requirements to ensure life safety. Modern security systems require an effective grounding infrastructure to ensure optimum performance of the wide variety of electronic security systems that may be used throughout the life of a building. The grounding and bonding requirements of this standard are additional technical security requirements beyond the scope of the NEC. These standards are intended to work in concert with the cabling topology specified in ANSI/TIA-568-C and installed in the pathways and spaces designed in accordance with ANSI/TIA-569-C.
- F. Americans With Disabilities ACT (ADA)
- 1. The Americans with Disabilities Act defines accessible design considerations such as spacing between equipment, room layouts, mounting heights, and device and communications requirements applicable to Electronic Safety and Security designs and installations. It also contains regulations concerning alarms and signage.
- G. Occupational Safety & Health Administration (OSHA)
- 1. Through the Occupational Safety and Health Administration, the federal government enforces the safety aspects of codes and standards that apply to employees' working conditions. Guidelines for good practice when installing electronic safety and security systems are defined in the following documents:
 - a. 29CFR1910, Title 29, Labor-Part 1910 OSHA Standards.
 - 1) 29CFR1926, Title 29, Labor-Part 1926 Safety & Health Regulations for Construction.
 - 2) Individual states may have their occupational safety divisions. Most states or localities accept certification of electrical products by a national testing laboratory as evidence that products and materials are safe for use in that jurisdiction.
- H. Underwriters Laboratories Inc. (UL)
- 1. In the United States, the Authority Having Jurisdiction (AHJ) typically requires UL testing and certification on electrical equipment. Some of the applicable standards are as shown below:
 - a. UL 294 (1999) Standard for Access Control System Units. UL 639 (1997) Standard for Intrusion-Detection Units.
- I. BICSI Electronic Safety & Security Design Reference Manual
- 1. The Building Industry Consulting Service International, Inc. (BICSI) is an information technology association whose mission is to provide the industry with state-of-the-art information technology and security knowledge, resulting in good service to the end user. BICSI develops and publishes the Electronic Safety and Security Design Reference Manual (ESSDRM). The ESSDRM is not a code or standard. The ESSDRM is an extensive volume of information on various security systems and distribution aspects.
 - a. The ESSDRM provides discussions and examples of various engineering methods and design solutions that can be selected and employed in order to meet the requirements of the NFPA and ANSI/TIA standards. Designers and installers are encouraged to use the ESSDRM as an engineering tool within the constraints of the UNT Security Infrastructure Standards requirements.
- 1.5 MINIMUM REQUIREMENTS
- A. References to industry and trade association standards and codes are minimum installation requirement standards.
 - B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.
 - C. Access control systems shall be designed and installed to neither interfere with egress requirements for life safety nor with intrusion or fire alarm systems.
 - D. All access-controlled handicap entrances shall be fully integrated into the building access control system, ensuring that while providing access to the disabled, proper access control is maintained in both the

unsecured and secured modes. Access control systems shall be installed to comply with the Americans with Disabilities Act and UNHSC policies.

- E. All access control installations shall use housings and mountings that maintain or minimize disruption to the buildings and campus's architectural sensibilities or themes.
- F. All access control installations shall use housings and mounting designed to provide sufficient protection against tampering and vandalism. Torx center pin security fasteners shall be used on all devices installed in public areas.
- G. All equipment and components to support the access control system shall be installed to the manufacturer's specifications. Installation of components and hardware shall be in place prior to connection to the access control system.
- H. Installations of control access system equipment hardware shall comply with requirements found in UNHSC Construction Standards.
- I. All access control systems shall be configured to provide a Fail Secure with mechanical manual egress from the secure side in case of a loss of power, network communications, or system failure.
- J. All access control equipped door locking hardware shall include keyed locking mechanisms accessible from the unsecured side to allow keyed manual operation of the door.
- K. All access control-equipped doors shall be keyed to a key system designated for access-controlled doorways.
- L. All access control doors shall be equipped with door position monitors and request-to-exit devices to allow for the configuration of door condition alarms.
- M. All access-controlled system equipment, including controllers and power supplies, shall be located in accessible and secure rooms, with Telecommunication/ IDF rooms being preferred.
- N. Electric power supplies and power converters for the access system equipment and hardware shall be connected in the Telecommunications/IDF room. Power supplies located at the access-equipped door should be avoided.
- O. Electrical service to access control power supplies shall be on dedicated circuits. Where practicable, the building emergency power supply should provide electric power for the access system.
- P. All access control equipment power supplies shall be equipped with battery backup to allow operation if electrical service and emergency-generated power are lost.
- Q. As a minimum, provide a conduit from all access devices, hardware, and equipment to the ceiling location to allow convenient access to raceways for cabling.
- R. All new construction installation of access control systems shall be hardwired. Hardwired installations are preferred in renovation or retrofit installations; wireless systems may be considered with the approval of Access Services, the Project Manager, and the building owner.
- S. Wiring Connection Requirements: All low-voltage control, monitor, power, and other cables shall be connected using sealed crimp-type lugs; no wire nuts will be allowed.
- T. Monitor Contacts: Door monitoring contacts, wiring, and conduits shall be concealed and invisible when the door is closed. Externally applied door monitoring contacts, externally applied conduit or wire mold, and Access Services, the Project Manager, and the building owner must approve wire without conduit.
- U. Request to Exit Switches: Request to exit (RX) switches should be mechanically hardware-based devices. Passive infrared (PIR) or sonic detectors must not be used.

PART 2 PRODUCTS

2.1 GENERAL

- A. Manufacturers' Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project and shall have manufactured the item for at least three years.
- B. Product Qualification:
 - 1. The manufacturer's product shall have been in satisfactory operation on three installations of similar size and type as this project for approximately three years.
 - 2. The University reserves the right to require the Contractor to submit a list of installations where the

products have been in operation before approval.

- C. Service Qualifications: A permanent service organization maintained or trained by the manufacturer shall render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit the name and address of service organizations.

2.2 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in manufacturing such items, for which replacement parts shall be available.
- B. When more than one unit of the same equipment class is required, such units shall be a single manufacturer's product.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and the total assembly for the intended service.
 - 4. Constituent parts that are similar shall be a single manufacturer's product.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
 - 1. The Owner shall have the option of witnessing factory tests. The Contractor shall notify UNHSC through the Construction Manager a minimum of 15 working days prior to the manufacturers making the factory tests.
 - 2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When equipment fails to meet factory tests and re-inspection is required, the Contractor shall be liable for all additional expenses, including expenses of the University.

2.3 EQUIPMENT REQUIREMENTS

- A. Where variations from the contract requirements are requested in accordance with Section 00 72 00, GENERAL CONDITIONS and Section 01 33 23, Shop Drawings, Product Data, And Samples, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels, and installation methods.

2.4 EQUIPMENT PROTECTION

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold, and rain:
 - 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items shall be protected against entry of foreign matter and be vacuum cleaned both inside and outside before testing, operating, and repainting if required.
 - 2. Damaged equipment shall be, as determined by the Resident Engineer, placed in first-class operating condition or returned to the supply source for repair or replacement.
 - 3. Painted surfaces shall be protected with factory-installed removable heavy kraft paper, sheet vinyl, or equal.
 - 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so that repaired areas are not obvious.

PART 3 EXECUTION

3.1 WORK PERFORMANCE

- A. Job site safety and worker safety are the responsibilities of the Contractor.
- B. For work on existing buildings, arrange, phase, and perform work always to ensure electronic safety and security service for other buildings. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. The Contractor's Project Manager shall attend a pre-installation meeting with the Owner and design team prior to working on the project.
- D. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL

REQUIREMENTS.

- E. Coordinate equipment location and conduit with other trades to minimize interferences. See Section 00 72 00, GENERAL CONDITIONS.

3.2 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Inaccessible Equipment:
 - 1. Where the University determines that the Contractor has installed equipment that is not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the University.
 - 2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit, and raceways.

3.3 EQUIPMENT IDENTIFICATION

- A. Install an identification sign that clearly indicates the information required for the use and maintenance of equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, at least 6 mm (1/4 inch) high—secure nameplates with screws. Nameplates furnished by the manufacturer as a standard catalog item or where another identification method is herein specified are exceptions.

3.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The University's approval shall be obtained for all equipment and materials before delivery to the job site. Delivery, storage, or installation of equipment or material without prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the University to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify the submitted equipment.
- D. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
 - 2. Submittals, including the section and paragraph numbers, shall be marked to show specification reference.
 - 3. Submit each section separately.
- E. The submittals shall include the following:
 - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data, and test reports as required.
 - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 - 3. Parts list, which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price, and availability of each part.
- F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
 - 1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies bound in hardback binders (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to the performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
 - 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.

3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
 4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation and maintenance instructions.
 - e. Safety precautions.
 - f. Diagrams and illustrations.
 - g. Testing methods.
 - h. Performance data.
 - i. The pictorial "exploded" parts list has part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and the name of the servicing organization.
 - j. Appendix: list qualified permanent servicing organizations for equipment support, including addresses and certified qualifications.
- G. Approvals will be based on the complete submission of manuals together with shop drawings.
- H. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:
1. A 300 mm (12 inches) length of each type and size of wire and cable, along with the tag from the coils of reels from which the samples were taken.
 2. Each conduit and pathway coupling, bushing, and termination fitting type.
 3. Conduit hangers, clamps and supports.
 4. Duct sealing compound.
- 3.5 SINGULAR NUMBER
- A. Where any device or part of the equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.
- 3.6 TRAINING
- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the Resident Engineer at least 30 days prior to the planned training.

END OF SECTION 280500

SECTION 281300 – ACCESS CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Security access devices.
- B. Access control panel.
- C. Intercom System

1.2 RELATED SECTIONS

- A. Section 087100 - Door Hardware.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.4 ACCESS CONTROL

- A. All access control and intrusion detection components shall be the most current model or version available and shall be compatible and interoperable with other installed systems such as digital video management, fire alarm, and building environmental control systems. The system shall be an IP-based open architecture type system that facilitates monitoring from numerous workstations throughout the system. The system shall provide an interface with client workstations in police offices on each individual campus and with the police dispatch center located on the Northeast campus.
- B. The Access Control system consists of sub-systems such as Access Control and Intrusion Detection servers, workstations and software, data gathering panels, LAN interface cards, card readers, door position sensors, and request-to-exit devices. The system shall allow for controlled entrances to be programmed to lock and unlock on a predetermined schedule. The security integrator shall coordinate with campus personnel to ascertain the desired door scheduling and program the system to meet the schedule. Each time an entry is made with a valid credential, the system shall record and store that information on the server to provide an audit trail of when a door was opened (date and time) and whose credential was presented for access (user's name and card number). The system shall also record and store the date and time of each alarm occurrence of a door being opened without the presentation of a valid credential or when a door remains open for longer than a preset time programmed in the software. This information shall be continuously displayed on server and workstation monitors and shall be recallable and printable from these stations. It is the responsibility of the security integrator to verify the proper operation of devices and systems prior to final acceptance.
- C. The card readers shall be proximity readers and be programmable from a server or workstation equipped with security software. Card readers shall work such that upon presentation of a valid ACID keycard, the unique card data shall be transmitted to an associated control panel where the data is compared to an authorized user database, and access is approved or rejected accordingly. A valid authorization will activate the operation of the electric lock and shunt the door status switch. The alarm shunt will not affect the supervision of the detection circuit.

1.5 SYSTEM DESCRIPTION

- A. Security Access System: Control access to the building using encoded cards:
 - 1. Selected Exterior Doors: Control access into the building.
 - 2. Selected Building Areas: Control access into restricted areas.

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Provide a system wiring diagram showing each device and wiring connection required.
- C. Product Data: Provide electrical characteristics and connection requirements.
- D. Test Reports: Indicate satisfactory completion of required tests and inspections.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by the product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Project Record Documents: Record actual locations of access authorization equipment.
- G. Operation Data: Operating instructions.
- H. Maintenance Data: Maintenance and repair procedures.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with a minimum of three years of documented experience and with service facilities within 100 miles of the Project.
- C. Installer Qualifications: The company specializing in installing the products specified in this section must have a minimum of three years of documented experience and MUST be a GE Strategic Partner.
- D. Products: Furnished products are listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.8 MAINTENANCE SERVICE

- A. Furnish service and maintenance of the security access system for one year from the Date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements for additional provisions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ~~Security Access System:~~
 - 1. Vanderbilt Industries
- B. ~~Intercom System~~
 - 1. Aiphone
 - 2. 2N

2.2 COMPONENTS

- A. ~~Security Access Control Client License:~~
 - 1. Product: Vanderbilt Industries
 - 2. Substitutions: Not allowed.
- B. ~~Encoded Card Readers:~~
 - 1. Product: Schlage MT15
 - 2. Product: Schlage MT11
- C. ~~PIR Exit Devices:~~

1. Product: Bosch/GE DS160.
 2. Substitutions: Not allowed.
- D. ~~Exit Buttons:~~
1. Product: Camden 5085RE
 2. Substitutions: Not allowed.
- E. ~~Electric Locks:~~
1. Refer to the door hardware specification section.
- F. ~~Single Door Module:~~
1. Product: Vanderbilt Industries VRI-1
 2. Substitutions: See Section 01 6000 - Product Requirements.
- G. ~~Dual Door Module:~~
1. Product: Vanderbilt Industries VRI-2.
 2. Substitutions: See Section 01 6000 - Product Requirements.
- H. ~~Input / Output Boards:~~
1. Product: Vanderbilt Industries VIONX-8
 2. Substitutions: See Section 01 6000 - Product Requirements.
- I. ~~Relay Output Boards:~~
1. Product: Vanderbilt Industries VI-16O
 2. Substitutions: See Section 01 6000 - Product Requirements.
- J. ~~Power Supplies:~~
1. Product: Altronix
 2. Substitutions: See Section 01 6000 - Product Requirements.
- K. ~~Card Access Cable:~~
1. Product: Belden B658AFS.
 2. Substitutions: See Section 01 6000 - Product Requirements.
- L. ~~Field Panels:~~
1. Product: Unity.
 2. Substitutions: See Section 01 6000 - Product Requirements.
- M. ~~Remote Intercom Devices~~
1. Aiphone IX Series
 2. 2N Surface Mounted – 02203-01
- N. ~~Master Intercom Devices~~
1. Aiphone IX Series
 2. 2N Desk Device – 01699-001

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with the manufacturer's instructions.
- B. Existing cabling at Kerr Hall Lobby Vestibule doors is to be demoed back to the designated Access Control Panel. New cabling to be installed, routed to the designated Access Control Panel, and terminated to existing components.
- C. Use 16 AWG minimum-size conductors for detection and signal circuit conductors. Install wiring in conduit.
- D. Make conduit and wiring connections to door hardware devices furnished and installed under Section 08 7100.

3.2 DEVICE POSITIONING

- A. Card readers shall be installed at an ADA-compliant height of 42" above grade. The door position sensors shall be concealed, flush-mounted units mounted on the top of the door frame approximately 4 to 6 inches from the opening edge of the door.

3.3 TEST PROCEDURES

- A. Field Test Reports: Upon completion and testing of the installed system, test reports shall be submitted in booklet form and electronic media showing all field tests performed on and adjustments made to each/any component and all field tests conducted to prove compliance with the specified performance criteria. Indicate and interpret test results in written form and verbally to owner/4b Technology for compliance with performance requirements at a pre-scheduled meeting.
 - 1. Specific test and verification requirements by demonstration or test are as follows. The owner reserves the right to witness any and all tests.
 - a. Following factory assembly and delivery, the security subcontractor shall individually test each component and sensor and verify the proper functioning of each element within a particular sub-system.
 - b. Following installation, individually test each component and sensor and verify the proper functioning of each element within a particular sub-system. Similarly, test each sub-system until all detection zones, alarm assessment components, alarm reporting and display, and access control functions have been verified. Prior to final functional and operational tests of the system, correct any deficiencies. After sub-system verification is complete, test the entire system to ensure that all elements are compatible and function properly as a whole system.
 - c. Upon completion of the above-outlined tests, conduct a formal test to be known as the "System Operational Test," in which all components and sub-systems of the security system are demonstrated to operate together as a system. This test is to be performed over a continuous seventy-two (72) hour period. A formal test plan and test procedures for each portion of the test shall be prepared by the security subcontractor and submitted to the Owner/Architect for approval. The subcontractor must demonstrate that the security system components and sub-systems meet specification requirements in the "As-Installed" operating environment during the "System Operational Test." While no formal environmental testing is required, temperature, humidity, and other environmental parameters should be measured and recorded. Include this data in the test report document for the "System Operational Test."

3.4 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Include services of a technician to supervise installation, adjustments, final connections, system testing, and to train UNT personnel.

3.6 DEMONSTRATION

- A. Demonstrate normal and abnormal modes of operation and the required response to each.
- B. Provide 8 hours of instruction each for two people.
 - 1. Conduct instruction at the project site with the manufacturer's representative.
 - 2. Include travel and living expenses for UNT personnel.

END OF SECTION 281300

SECTION 282300 - VIDEO SURVEILLANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cameras.
- B. Control equipment.
- C. Cable and accessories.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.3 SYSTEM DESCRIPTION

- A. The UNT video surveillance system is an Internet Protocol (IP) camera-based system that runs off of signal and low voltage power generated by a Power over Ethernet (PoE) data network switch and using signals transmitted over Local and Wide Area Network cable.
- B. All cabling used for camera image transmission is the same type used for high-end data networks, Category 6 Unshielded Twisted Pair copper. Communications specifications sections should be adhered to for the installation of Category 6 cabling.
- C. Camera data is recorded and viewed from an existing central storage device.
- D. Camera software licenses may be required to add additional cameras to the existing system.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements, including system wiring diagram.
- C. Product Data: Provide a showing of each component's electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by the product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- E. Project Record Documents: Record actual locations of cameras and routing of television cable.
- F. Operation Data: Instructions for starting and operating the system.
- G. Maintenance Data: Routine troubleshooting procedures.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with a minimum of three years of documented experience and with service facilities within 100 miles of the Project.
- C. Supplier Qualifications: Authorized distributor of specified manufacturer with a minimum of three years of documented experience.
- D. Installer Qualifications: Authorized installer of the specified manufacturer with service facilities within 100 miles of the Project.

- E. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 MAINTENANCE SERVICE

- A. Furnish service and maintenance of the television system for one year from the Date of Substantial Completion.

PART 2 PRODUCTS

2.1 COMPONENTS – CAMERAS

- A. Indoor/Outdoor Fixed Dome: Panasonic / i-Pro WV-S25500-F3L
- B. Indoor 360: Panasonic / i-Pro WV-S8544L

2.2 ACCESSORIES

- A. Main Video Cable: Category 6
 - 1. Product: As determined by Section 27 15 00.
- B. Cabinet: Free-standing equipment rack (Provided by Communications Installer).
 - 1. Size: As indicated.

2.3 VMS, LICENSES AND STORAGE

- A. Video Management System – Video Insight 7
- B. Provide all camera licenses as required for a fully functional system
- C. Provide a quote for a Video Insight IP Server and storage to allow for 30 days of storage at 16 hours of motion per day to estimate total storage needs.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install per the manufacturer's instructions.
- B. Existing cabling is to be protected during demolition and reused during the renovation.
- C. Existing devices are to be removed and given to the Client for reuse in the renovation.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Interface installation of video surveillance with security access and intrusion detection systems.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide the services of the manufacturer's technical representative to prepare and start systems and supervise final wiring connections and system adjustments.

3.4 ADJUSTING

- A. Adjust manual lens irises to meet lighting conditions.

3.5 DEMONSTRATION

- A. Demonstrate system operation and provide two hours of instruction with manufacturer's training personnel.
- B. Conduct a walking tour of the Project and briefly describe each component's function, operation, and maintenance.

END OF SECTION 282300