

PROJECT MANUAL

ISSUED FOR BID

September 13, 2023

OAKTON COLLEGE
TENHOEVE FIT OUT

DES PLAINES, IL

Perkins&Will Project Number: 021047.000

Perkins&Will

410 N Michigan Ave, Suite 1600, Chicago, IL 60611 | 312.755.0770

PROJECT MANUAL

OAKTON COLLEGE TENHOEVE FIT OUT DES PLAINES, IL

September 13, 2023

Issued for Bid

Owner

Oakton College
1600 Golf Road
Des Plaines, IL 60016

Architect

Perkins&Will
410 North Michigan Avenue, Suite 1600
Chicago, IL 60611
Telephone: 312-755-0770

MEP Engineer

Mechanical Services Associates
111 S. Virginia Street
Crystal Lake, IL 60014
Telephone: 815-788-8901

Project Numbers

PW Project Number: 021047.000

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PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 01 25 00 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

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

1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
 - 3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing in compliance with the following requirements:
 - 1. Requests for substitution of materials and equipment will be considered if received no later than seven (7) calendar days prior to date of bid opening.

2. Submittal Format: Submit three copies of each written Procurement Substitution Request, using form bound in Project Manual.
 - a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
 - b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
 - 1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
 - 2) Copies of current, independent third-party test data of salient product or system characteristics.
 - 3) Samples where applicable or when requested by Architect.
 - 4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. 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.
 - 5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - 6) Research reports, where applicable, evidencing compliance with building code in effect for Project, from ICC-ES.
 - 7) 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 become necessary to accommodate the proposed substitute.
 - c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
 - d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.
- B. Architect's Action:
 1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

- C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

1.5 ATTACHMENTS

- A. Substitution Request Form (Procurement Period).

**SUBSTITUTION REQUEST FORM
(Procurement Period)**

TO: PERKINS&WILL
410 N. Michigan Ave., Suite 1600
Chicago, IL 60611

From: _____

Substitution Request No: _____ DATE: _____

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

PROJECT SPECIFICATION

Specification Name/Number _____

Article, Paragraph, Page Number _____

Item/System to be Substituted _____

REASON FOR SUBSTITUTION REQUEST

SPECIFIED PRODUCT . . .

PROPOSED PRODUCT . . .

Is no longer available.
Time

Will reduce the Construction
by _____ days.

Is unable to meet project schedule.

Is unsuitable for the designated application.

Will reduce the Contract Sum

Cannot interface with adjacent materials.

by \$ _____.

Is not compatible with adjacent materials.

Cannot provide the specified warranty.

Cannot be constructed as indicated.

Other: _____

Cannot be obtained due to one or more of the following:

Strike

Bankruptcy of manufacturer or supplier

Lockout

Similar occurrence

Explanation of each item marked above (attach documentation):

EFFECT OF SUBSTITUTION

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

Proposed substitution requires dimensional revisions or redesign of architectural, structural, mechanical, electrical, plumbing, life safety, or other work:

No Yes (if yes, attach data explaining revisions)

PRODUCT COMPARISON

Provide side-by-side comparison between proposed substitution and specified product to facilitate review of Substitution Request:

SPECIFIED PRODUCT	PROPOSED PRODUCT
Manufacturer: _____	_____
Name / Brand: _____	_____
Catalog No.: _____	_____
Supplier: _____	_____
Features: _____	Variations: _____
_____	_____
_____	_____
(Attach additional sheets if necessary)	(Attach additional sheets if necessary)

Local Distributor or Supplier: _____
Manufacturer's Representative: _____
Maintenance Service Available: Yes No
Spare Parts Source and Location: _____
Warranty Available is equivalent to the specified warranty: Yes No
_____ Years
Describe any variation from specified warranty: _____

Product Manufacturing History New 2-5 yrs 6-10 yrs More than 10 yrs old

SUPPORTING DATA ATTACHED (REQUIRED WHERE APPLICABLE)

- Point-by-point comparison of performance criteria, materials, and components of specified product with proposed substitution.
- Drawings Specifications Product Data Samples
- Tests Reports Sustainable Compliance Warranty

REFERENCED INSTALLATIONS

Identify at least **three** similar local projects on which proposed substitution was recently used:

PROJECT #1:

Project: _____ Date Installed: _____

Address: _____

Architect: _____

Contact: _____ Phone: _____

Owner: _____

Facility Manager: _____ Phone: _____

Contractor: _____

Contact: _____ Phone: _____

PROJECT #2:

Project: _____ Date Installed: _____

Address: _____

Architect: _____

Contact: _____ Phone: _____

Owner: _____

Facility Manager: _____ Phone: _____

Contractor: _____

Contact: _____ Phone: _____

PROJECT #3:

Project: _____ Date Installed: _____

Address: _____

Architect: _____

Contact: _____ Phone: _____

Owner: _____

Facility Manager: _____ Phone: _____

Contractor: _____

Contact: _____ Phone: _____

ACKNOWLEDGEMENTS: The undersigned certify that:

- **Performance:** Proposed substitution has been fully investigated and determined to be equal or superior in all respects to the specified product, including appearance, quality, performance, code compliance, service life, and sustainability compliance.
- **Warranty:** Same warranty will be furnished for proposed substitution as was required for the specified product.
- **Sustainability Compliance:** Same contribution to sustainability program as required.
- **Operations and Maintenance:** Same maintenance service and source of replacement parts, as applicable, are available locally for the proposed substitution.
- **No Adverse Effect:** Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- **No Adverse Time or Cost:** Claims for additional costs or time related to accepted substitution which may subsequently become apparent are waived.
 - Payment will be made to the Owner for changes to the project design, including Architect's and Engineer's redesign fees, and engineering, detailing, special inspection, and construction costs incurred by the Owner caused by acceptance of the substitution.
 - Coordination to fully integrate the proposed substitution and associated modifications to the Work will be performed.
 - If substitution is accepted, all costs associated with fully integrating the proposed substitution into the Work are included in the Contractor's Bid.

- **Dimensions and Clearances:** Proposed substitution does not affect dimensions or functional clearances.
- **Conditions of Acceptance:** The Architect's recommendation for approval, if granted, relies on data submitted and the opinion and knowledge of the Architect at the time decision is rendered. The approval is conditional in nature and subject to re-evaluation and reconsideration if additional data or materials are submitted, or coordination with other work is observed to invalidate claims that substitution is equal to items originally specified.

Contractor: _____
(Name of Contractor)

Date: _____ By: _____

Subcontractor: _____
(Name of Subcontractor)

Date: _____ By: _____

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

ARCHITECT'S REVIEW AND ACTION

- Substitution acceptance is recommended.
- Substitution acceptance is recommended, with the following comments:

- Architect's additional services proposal attached.
- Resubmit Substitution Request:
 - Provide the following: _____
 - Provide itemized proposal indicating amount of savings to Owner
- Substitution acceptance is not recommended:
 - 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 material revisions to Contract Documents.

PERKINS&WILL

Perkins&Will acknowledges its' reliance upon information provided by the Bidder, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to not comply with requirements of the Bidding Documents or Contract Documents, the Bidder / Contractor shall provide the specified product at no additional cost to Owner.

By: _____ Date: _____

END OF FORM

DOCUMENT 00 41 13

BID FORM

TO: _____
(Name of Owner)

Attn.: _____

PROJECT: _____

FOR: _____
(Name of Facility)

FROM: _____
(Name of Bidder)

DATE: _____

REPRESENTATIONS

The undersigned, in compliance with the Invitation to Bid and Instructions to Bidders for the above referenced Project, having examined the Drawings and Specifications, together with the related Bidding Documents and all conditions surrounding the Work, and having visited the site of the proposed Work, hereby proposes to furnish all work in every detail in accordance with the Bidding Documents within the time set forth herein and at the prices stated below. These prices shall cover all expenses incurred in performing the Work under the Bidding Documents, of which this Bid is a part.

In submitting this Bid, Bidder represents, as more fully set forth in the Agreement, that:

- A. This Bid will remain subject to acceptance for 60 days after the day of the Bid opening;
- B. The Owner has the right to reject this Bid;
- C. Bidder will sign and submit the Agreement, along with the Performance Bond, Payment Bond, and Certificate of Insurance, within 10 days after the date of the Owner's notice of award;
- D. Bidder has carefully examined copies of all the Bidding Documents;
- E. Bidder has visited the site and become familiar with the general, local, and site conditions;
- F. Bidder is familiar with federal, state, and local laws and regulations;
- G. The undersigned is an authorized representative of the Bidder;
- H. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the site, reports and drawings identified in the Bidding Documents and additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.

- I. This Bid is genuine and not made in the interest of or on behalf of an undisclosed person, firm, or corporation and is not submitted in conformity with an agreement or rules of a group, association, organization, or corporation; Bidder has not directly or indirectly induced or solicited another Bidder to submit a false or sham Bid; Bidder has not solicited or induced another person, firm, or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself an advantage over another Bidder or over the Owner.

ADDENDA

The undersigned agrees that the following Addenda, which have been issued during the bidding period, have been received and have been considered both before and in the preparation of this Bid:

Addendum No. _____	Date: _____	Initial _____
Addendum No. _____	Date: _____	Initial _____
Addendum No. _____	Date: _____	Initial _____
Addendum No. _____	Date: _____	Initial _____
Addendum No. _____	Date: _____	Initial _____

BASE BID

Having examined the Drawings, Specifications, and all other Bidding Documents for _____ and having examined the premises and circumstances affecting the Work, the undersigned hereby presents the following offer:

OFFER: To furnish all labor, material, tools, equipment, transportation, bonds, all applicable taxes, incidentals, and other facilities, and to perform all Work for the total Base Bid amount of.

_____ Dollars
(in words)

(\$ _____).
(in figures)

(Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.)

UNIT PRICES

The undersigned hereby agrees that each Unit Price submitted represents full compensation for either additions to or deductions from the Contract Sum in the event actual quantities of work in place differ from those indicated in the Contract Documents. Adjustments shall be made in accordance with applicable Division 01 - General Requirements Sections.

- A. UNIT PRICE NO. 1 – Water Vapor Emission Control System:
Synthetic Resin Polymer Treatment. ADD per square foot: \$_____

COMPLETION DATE

The Undersigned, if notified of the acceptance of this Bid within sixty (60) days after the date set for the receipt of Bids, agrees to deliver the required Certificate of Insurance, Performance Bond in the amount of ONE HUNDRED PERCENT (100%) of the proposed Contract Sum for the faithful performance of the Work, and a ONE HUNDRED PERCENT (100%) Payment Bond, and to execute the Agreement within ten (10) days thereafter and, if approved by the Owner, agrees to enter into a contract for the Work for the above-stated Bid Sum.

The Bidder further agrees to begin Work on the Project within seven (7) days after receiving written Notice to Proceed by the Owner, and to achieve Substantial Completion of the Work in not more than _____ consecutive calendar days thereafter.
(To be filled in by Bidder)

This schedule of completion of the Work shall be considered of the essence of the contract, and the Work accordingly shall be substantially complete within the stipulated time, subject to extensions of time as provided in the General Conditions.

BID ACKNOWLEDGEMENT

The undersigned affirms that they are duly authorized to execute this Bid, that this company, corporation, firm, partnership, or individual has not prepared this Bid in collusion with any other bidder, and that the contents of this Bid as to prices, terms, or conditions of said Bid have not been communicated by the undersigned nor by any employee or agent to any other person engaged in this type of business prior to the official opening of this Bid.

Bidder's authorized signature

Date

Firm Name: _____

Address: _____

City: _____ State _____

Corporate Seal (if corporation):

Telephone: _____

Facsimile: _____

Email: _____

END OF DOCUMENT

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project information.
- B. Work covered by Contract Documents.
- C. Contractor duties.
- D. Access to site.
- E. Protection of persons, work, and property.
- F. Coordination with occupants.
- G. Work restrictions.
- H. Specification and Drawing conventions.
- I. Provisions for electronic media.

1.2 RELATED REQUIREMENTS:

- A. Section 01 50 00 - Temporary Facilities and Controls for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Oakton College - Tenhoeve Fit Out
 - 1. Project Location: 1600 Golf Road, Des Plaines, Illinois 60016.
- B. Owner: Oakton College.
- C. Architect Identification: The Contract Documents were prepared for the Project by Perkins&Will, 410 N Michigan Ave, Suite 1600, Chicago, IL 60611; telephone 312-755-0770.
- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Refer to Title Page.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 1. Interior renovations for new office space and other Work indicated in the Contract Documents.
- B. Type of Contract:
 1. Project will be constructed under a single prime contract.

1.5 CONTRACTOR DUTIES

- A. VOC Compliance: Ensure that all assemblies, components, and systems comply with all VOC (Volatile Organic Components) requirements and regulations of the Environmental Protection Agency (EPA), Occupational Safety Health Administration (OSHA), State, County, City, and Local Air Control District.
 1. See Divisions 02 through 28 for Project VOC Restrictions.
- B. Except as specifically noted, provide and pay for:
 1. Labor, materials, and equipment.
 2. Tools, construction equipment and machinery.
 3. Water, heat, and utilities required for construction.
 4. Other facilities and services necessary for proper execution and completion of work.
- C. Give required notices.
- D. Comply with all applicable local Building Codes, ordinances, rules, regulations, orders and other legal requirements of public authorities which bear on performance of Work.
- E. Promptly submit written notice to Architect of observed variance of Contract Documents from requirements of authorities having jurisdiction. Assume responsibility for Work known to be contrary to code or regulatory requirements performed without such notice.

1.6 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limit use of site for work and storage as follows:
 - a. Do not use completed paved areas for storage without Owner's approval.
 - b. Do not store materials within 25 feet of new or existing trees.
 - c. Restrict Work and storage to areas indicated on Drawings or approved by Owner.
 - d. Limit site access to locations approved by Owner.
 - e. Restrict parking to areas approved by Owner.
 - f. Do not perform operations that would interrupt or delay Owner's daily operations.
 - 2. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet (12.2 m) beyond building perimeter; 10 feet (3 m) beyond surface walkways, patios, surface parking, and utilities less than 12 inches (300 mm) in diameter; 15 feet (4.5 m) beyond primary roadway curbs and main utility branch trenches; and 25 feet (7.6 m) beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.
 - 3. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment onsite.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 PROTECTION OF PERSONS, WORK, AND PROPERTY

- A. Contractor shall maintain adequate protection of the Work from damage and shall protect the Owner's and adjacent property from injury or loss arising from the Work.
 - 1. Repair damage to existing buildings, property, and site caused by employees, subcontractors, or consultants.
- B. Contractor shall provide and always maintain OSHA-required danger signs, guards, and obstructions necessary to protect the public and construction personnel from any dangers inherent with or created by the construction of the Work.
 - 1. Comply with federal, state, and city rules and requirements pertaining to safety, and all EPA standards, OSHA standards, and NESHAP regulations pertaining to asbestos and other hazardous materials.

1.8 COORDINATION WITH OCCUPANTS

- A. 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.
 - 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.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.

3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.9 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7 a.m. to 7 p.m., Monday through Friday, unless otherwise indicated.
 1. Hours for Core Drilling and other noisy activities: Coordinate with Owner. Perform during hours when building is least occupied.
 2. Obtain approval from Owner for work outside of these hours.
- 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. Notify Architect not less than two days in advance of proposed utility interruptions.
 2. Obtain Architect'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. Notify Architect not less than two days in advance of proposed disruptive operations.
 2. Obtain Architect's written permission before proceeding with disruptive operations.
- E. Nonsmoking Property: Smoking is not permitted within the building or on Owner's property.
- F. Restricted Substances: Use of tobacco products and other controlled substances within existing building and on Project site is not permitted.
- G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

- H. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specifications Format: The Specifications are organized into Divisions and Sections using CSI/CSC's "MasterFormat 2020" 50-Division numbering system.
 - 1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence, without all numbers included in the sequence. Consult the Table of Contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
 - 2. The order of articles, paragraphs, subparagraphs, and sub-subparagraphs within the text of any Specification section is defined by a sequence of indentations.
 - a. Article, paragraph and subparagraph titles, and other identifications of subject matter in the Specifications, are intended as an aid in locating and recognizing various requirements in the beginning words of a sentence.
 - b. Specification text shall govern over titling and shall be understood to be interpreted as a whole. Where a title establishes the subject, the titles are subordinate to and do not define, limit, or otherwise restrict the Specification text.
 - 3. The captions and headings of various subdivisions of the Contract Documents are intended only as a matter of reference and convenience for describing the Work and in no way define, prescribe, or limit the scope or intent of the Contract Documents or any subdivision thereof.
- B. 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. 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.
 - b. Contract Documents may omit modifying words such as "all" or "any," and articles such as "the" or "an." The absence of a modifier or article from one statement that appears in another is not intended to affect the interpretation of either statement.
 3. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
 4. The Specifications do not:
 - a. Establish trade jurisdictions or divisions of responsibility.
 - b. Define subcontract scopes of work.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Work specified in any one Section is related to, and dependent upon, Work specified in other Sections, whether or not specific reference is made to the Work of other Sections. Cross-references in the Specifications are general references intended as a matter of convenience for aiding in the location general information and are not all-inclusive.
- E. Names, telephone numbers, and website addresses and other contact information listed in the Contract Documents are for convenience only, are subject to change, and are believed to be accurate and up to date as of the printing of the Contract Documents.
- F. Use of the word "including," when following any general statement, shall not be construed to limit such statement to specific items or matters listed, whether or not non-limiting language (such as "without limitation," "but not limited to," or other words of similar import) is used with reference thereto; but rather, shall be deemed to refer to all other items or matters that could reasonably fall within the broadest possible scope of such general statement.
- G. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

1.11 PROVISIONS FOR ELECTRONIC MEDIA

- A. Digital Data Files: Electronic drawing/model files of the Contract Drawings will not be furnished by Architect for Contractor's use in preparing submittals unless procedures stated within Section 01 33 00 - Submittal Procedures are agreed to and Contractor executes the Agreement Form, and the Contractor properly prepares and submits the Submittals Schedule as indicated in Section 01 32 00 - Construction Progress Documentation
- B. For the duration of this Project, it is the intent to distribute information in electronic format where allowable. Drawings, Specifications, Contract Document Modifications, memoranda, letters or other documents issued in the normal course of execution of the Work will be issued and distributed in electronic format (.pdf).
 1. Costs associated with printing and distribution of the project information shall be included in the Contract Sum.
 2. Printed documents will be provided and expected only for documents that are required to be in paper format by this Contract, Authorities Having Jurisdiction, or other statutory requirements.
 - a. Drawings that require revision will be reissued for replacement as full-size sheets.
 - b. Specifications that require revision will be reissued as complete replacement Specification Sections.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 22 00

UNIT PRICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for unit prices.

1.2 RELATED REQUIREMENTS

- A. Section 01 26 00 - Contract Modification Procedures for procedures for submitting and handling Change Orders.
- B. Section 01 40 00 - Quality Requirements for general testing and inspecting requirements.

1.3 DEFINITIONS

- A. Unit price as 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 materials, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See 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.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

- A. Refer to individual Sections of Specifications for the descriptions of units of work where the establishment of unit prices is required; the methods of measurement and pricing are specified therein.

3.2 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 01 – Water Vapor Emission Control System: Refer to Section 09 05 61.13 - Moisture Vapor Emission Control.
 - 1. Provide cost per square foot for complete system, including shot-blasting concrete substrate, application of penetrant, post-application moisture and alkalinity testing, application of cementitious underlayment, and manufacturer's 15-year warranty.
- B. Unit Price No. 02 - Hydraulic Cement Based Underlayment: Refer to Section 03 54 16 - Cement-Based Underlayment.
 - 1. Provide cost per square foot for cement-based, polymer-modified, self-leveling underlayment for broad scope leveling of existing and new concrete flooring scheduled to have new flooring applied.

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for submitting and processing requests for product substitutions after the award of the construction contract.

1.2 RELATED REQUIREMENTS

- A. Section 01 21 00 - Allowances for products selected under an allowance.
- B. Section 01 23 00 - Alternates for products selected under an alternate.
- C. Section 01 26 00 - Contract Modification Procedures for determining which modification method and forms are appropriate.
- D. Section 01 60 00 - Product Requirements for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Electronically submit a PDF copy 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 form provided by Architect.

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 revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed 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 model code organization acceptable to the authorities having jurisdiction.
 - 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.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

- B. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
1. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 2. Acceptance, if granted, will be based on reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered. 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.
 3. In proposing items for consideration, Contractor assumes all risk, costs, and responsibility for item's final acceptance, compliance with Contract Documents, integration into the Work, and performance.
 4. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.
- B. Substitution Request for products, assemblies, and equipment constitutes a representation that the Contractor:
1. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 2. Has confirmed that the proposed substitution does not affect dimensions or functional clearances.
 3. Agrees to provide the same warranty for the substitution as for the specified product.
 4. Agrees to coordinate installation and make changes to other work that may be required for no additional cost to the Owner.
 5. Waives claims for additional costs or time extension that may subsequently become apparent.

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

1.8 ATTACHMENTS

- A. Post-Award Substitution Request Form.

OAKTON COLLEGE
TENHOEVE FIT OUT
ISSUED FOR BID

PERKINS&WILL
021047.000
SEPTEMBER 13, 2023

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SUBSTITUTION PROCEDURES
01 25 00 - 5

SUBSTITUTION REQUEST FORM

(For use after Procurement phase)

TO: Perkins&Will
410 N Michigan Ave, Ste. 1600
Chicago, IL 60611

From: _____

Substitution Request No: _____ DATE: _____

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

PROJECT SPECIFICATION

Specification Name/Number: _____
Article, Paragraph, Page Number: _____
Item/System to be Substituted: _____

REASON FOR SUBSTITUTION REQUEST

SPECIFIED PRODUCT . . .

PROPOSED PRODUCT . . .

- | | |
|--|--|
| <input type="checkbox"/> Is no longer available. | <input type="checkbox"/> Will reduce the Contract Time
by _____ days. |
| <input type="checkbox"/> Is unable to meet project schedule. | <input type="checkbox"/> Will reduce the Contract Sum
by \$ _____. |
| <input type="checkbox"/> Is unsuitable for the designated application. | |
| <input type="checkbox"/> Cannot interface with adjacent materials. | |
| <input type="checkbox"/> Is not compatible with adjacent materials. | |
| <input type="checkbox"/> Cannot provide the specified warranty. | |
| <input type="checkbox"/> Cannot be constructed as indicated. | <input type="checkbox"/> Is an Owner-initiated substitution |
| <input type="checkbox"/> Other: _____ | |
| <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 |
| <input type="checkbox"/> Lockout | <input type="checkbox"/> Similar occurrence |

Explanation of each item marked above (attach documentation):

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, mechanical, electrical, plumbing, life safety, or other work:

No Yes (if yes, attach data explaining revisions)

PRODUCT COMPARISON

Provide side-by-side comparison between proposed substitution and specified product to facilitate review of Substitution Request:

SPECIFIED PRODUCT:

PROPOSED PRODUCT:

Manufacturer: _____

Name / Brand: _____

Catalog No.: _____

Supplier: _____

Features: _____

Variations: _____

(Attach additional sheets if necessary)

(Attach additional sheets if necessary)

Local Distributor or Supplier: _____

Manufacturer's Representative: _____

Maintenance Service Available: Yes No

Spare Parts Source and Location: _____

Warranty Available is equivalent to the specified warranty: Yes No _____ Years

Describe any variation from specified warranty: _____

Product Manufacturing History New 2-5 yrs 6-10 yrs More than 10 yrs old

SUPPORTING DATA ATTACHED (REQUIRED WHERE APPLICABLE)

Point-by-point comparison of performance criteria, materials, and components of specified product with proposed substitution.

- Drawings Specifications Product Data Samples
- Tests Reports LEED Compliance Warranty

REFERENCED INSTALLATIONS

Identify at least **three** similar local projects on which proposed substitution was used:

PROJECT #1:

Project: _____ Date Installed: _____

Address: _____

Owner: _____

Contact: _____ Telephone: _____

Architect: _____

Contact: _____ Telephone: _____

Contractor: _____

Contact: _____ Telephone: _____

PROJECT #2:

Project: _____ Date Installed: _____

Address: _____

Owner: _____

Contact: _____ Telephone: _____

Architect: _____

Contact: _____ Telephone: _____

Contractor: _____

Contact: _____ Telephone: _____

PROJECT #3:

Project: _____ Date Installed: _____

Address: _____

Owner: _____

Contact: _____ Telephone: _____

Architect: _____

Contact: _____ Telephone: _____

Contractor: _____

Contact: _____ Telephone: _____

ACKNOWLEDGEMENTS: The undersigned certify that:

- **Performance:** Proposed substitution has been fully investigated and determined to be equal or superior in all respects to the specified product, including appearance, quality, performance, code compliance, and sustainability compliance.
- **Warranty:** Same warranty will be furnished for proposed substitution as for specified product.
- **LEED Compliance (LEED projects only):** Same contribution to LEED program.
- **Operations and Maintenance:** Same maintenance service and source of replacement parts, as applicable, are available locally for the proposed substitution.
- **No Adverse Effect:** Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- **No Adverse Time or Cost:** Cost data and time as stated above are complete. Contractor bears all costs for labor and materials associated with fully integrating proposed substitution into the Project. Claims for additional costs or time related to accepted substitution which may subsequently become apparent are waived.
 - Payment will be made to the Owner for changes to the project design, including Architect's and Engineer's redesign fees and engineering, detailing, special inspection, and construction costs incurred by the Owner caused by acceptance of the substitution.
 - Coordination necessary to fully integrate the proposed substitution, and any associated modifications to related or adjacent Work, have been or will be performed.
- **Dimensions and Clearances:** Proposed substitution does not affect dimensions or functional clearances.
- **Conditions of Acceptance:** The Architect's recommendation for approval, if granted, relies on data submitted and the opinion and knowledge of the Architect at the time decision is rendered. The approval is conditional in nature and subject to reevaluation and reconsideration if additional data or materials are submitted, or coordination with other work is observed to invalidate claims that substitution is equal to item originally specified.

Contractor: _____
(Name of Contractor)

Date: _____ By: _____

Subcontractor: _____
(Name of Subcontractor)

Date: _____ By: _____

Note: Substitution requests are not part of the standard submittal process and shall not be submitted as part of Shop Drawings, Product Data, or Samples submittals. Substitution requests must be filled out completely. Unresponsive or incomplete requests will be rejected and returned without review.

ARCHITECT'S REVIEW AND ACTION

- Substitution acceptance is recommended.
- Substitution acceptance is recommended, with the following comments: _____

- Architect's additional services proposal attached.
- Resubmit Substitution Request:
 - Provide the following: _____
 - Provide proposal indicating amount of savings / credit to Owner
- Substitution acceptance is not recommended:
 - 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.
 - Design Team has no experience with product / manufacturer and is therefore unable to comment on the track record of quality, performance, or reliability.
 - Proposed product will require substantial revisions to Contract Documents.

PERKINS&WILL

Perkins&Will acknowledges its reliance upon 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 not comply with requirements of the Contract Documents, the Contractor shall be solely responsible for performance of the work in accordance with requirements of the Contract Documents.

By: _____ Date: _____

OWNER'S REVIEW AND ACTION

- Substitution is accepted; Architect to prepare Change Order.
- Substitution is not accepted.

By accepting this substitution, Owner agrees to compensate Perkins&Will for additional services, if any, necessary to implement the substitution.

Additional Services: \$ _____

By: _____ Date: _____

(Owner's Representative)

END OF FORM

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for handling and processing Contract modifications.

1.2 RELATED REQUIREMENTS

- A. Section 01 21 00 - Allowances for procedural requirements for handling and processing allowances.
- B. Section 01 22 00 - Unit Prices for administrative requirements for using unit prices.
- C. Section 01 25 00 - Substitution Procedures for administrative procedures for handling requests for substitutions made after the Contract award.
- D. Section 01 31 00 - Project Management and Coordination for administrative procedures for handling RFIs.

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

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

2. Contractor's Action: Within 10 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include separate costs of labor, materials, equipment and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use form acceptable to Architect.

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

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 01 21 00 - Allowances for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 01 22 00 - Unit Prices for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

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

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 RELATED REQUIREMENTS

- A. Section 01 21 00 - Allowances for procedural requirements governing the handling and processing of allowances.
- B. Section 01 22 00 - Unit Prices for administrative requirements governing the use of unit prices.
- C. Section 01 26 00 - Contract Modification Procedures for administrative procedures for handling changes to the Contract.
- D. Section 01 32 00 - Construction Progress Documentation for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
- E. Section 01 81 13 "Sustainable Design Requirements" for administrative requirements governing submittal of cost breakdown information required for LEED documentation.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's Construction Schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. 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. If required, include evidence of insurance that covers items stored at a bonded warehouse, and during transport to the project site.
 4. Provide separate line items in the Schedule of Values for each part of the Work where Applications for Payment may include cost of submittals.
 - a. Cost for submittals shall represent true cost of submittals preparation, as evidenced by subcontractor invoices, but not to exceed 5 percent of the total value of that item of work line item.

5. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
6. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
8. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is the 20th day of each month. The period covered by each Application for Payment starts on the day following the end of the preceding period and ends 15 days before the date for each progress payment.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 1. Other Application for Payment forms proposed by the Contractor shall be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.

3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit PDF of Application for Payment to Architect within 24 hours. Include waivers of lien and similar attachments if required.
1. Provide transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Preparation and Submittal of Draft of Initial Application for Payment (Pencil Copy):

1. Prepare draft copy of Application for Payment and meet with Owner and Architect to review the draft copy prior to submittal of the Application for Payment.
 2. Provide four (4) draft (pencil) copies within two (2) business days before the day of the review meeting with Owner and Architect. Submit substantiating data with each application copy: subcontractor applications for payment, copies of invoices, storage receipts, and data required by Owner
 3. After review of draft (pencil) copy by Owner, Architect, and Contractor, prepare Application for Payment, using agreed-upon data on Owner/Architect-reviewed schedule of values and Owner/Architect-reviewed pencil draft.
 4. Include specified information required for application preparation.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. Copy of executed Agreement between Owner and Contractor.
 2. List of subcontractors.
 3. Schedule of values.
 4. Contractor's construction schedule (preliminary if not final).
 5. Products list (preliminary if not final).
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
 14. Certificates of insurance and insurance policies.
 15. Performance and payment bonds.
 16. Data needed to acquire Owner's insurance.
- J. Payment Applications During Construction: Submit changes in submittals schedule, construction schedule, and other schedules with each application for payment.
- K. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- L. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. Evidence that claims have been settled.
 5. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 6. Final liquidated damages settlement statement.
 7. Include documentation that the facility has been inspected by a registered or licensed representative of the state's Department of Licensing and Regulations and that any items noted as non-compliant have been corrected and approved.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Requests for Information (RFIs).
 - 3. Digital project information management.
 - 4. Project meetings.

1.2 RELATED REQUIREMENTS

- A. Section 01 31 06 - Coordination Drawings for coordination drawing requirements.
- B. Section 01 32 00 - Construction Progress Documentation for preparing and submitting Contractor's construction schedule.
- C. Section 01 73 00 - Execution for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
- D. Section 01 77 00 - Closeout Procedures for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request from Owner, Architect, or Contractor seeking information required for clarifications of the Contract Documents.
- C. PIMS: Web-based Project Information Management System managed by the Contractor and for use by Owner, Owner's Consultants, Architect and Architect's Consultants.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
 4. Post list on PIMS and always keep current.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, on PIMS and in prominent location in built facility. Always keep list current.
- C. Administrative and Personnel: In addition to Project superintendent, identify other administrative and supervisory personnel as required for proper performance of the Work. Identify individuals and their duties and responsibilities; list their addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Include personnel required for coordination of operations with other contractors.
- D. Coordination Drawings: Refer to Section 01 31 06 - Coordination Drawings.

1.5 GENERAL COORDINATION PROCEDURES

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

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
 4. Where availability of space is limited, coordinate installation of components to ensure maximum performance and accessibility for required maintenance, service, and repair of components, including mechanical and electrical.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work.
- C. Conservation: Coordinate construction activities to ensure operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarifications or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Contractor shall submit RFIs to Architect using PIMS.
 2. Architect shall provide Contractor with a list of design team contacts by discipline for RFI distribution.
 3. Concurrent with submission to the Architect, Contractor shall also distribute RFIs to appropriate design team professionals, using PIMS, based on the disciplines affected by the RFI.
 4. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 5. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
 6. Include only one subject or item per RFI. RFIs that include more than one subject or item will be returned without review to the Contractor.

- B. Contractor's failure to report discrepancies or omissions in the Contract Documents, or Contractor- or Subcontractor-generated assumptions, in lieu of Architect-issued clarifications regarding the intent of the Contract Documents, shall not be used as a basis for future claims once the apparent discrepancies or omissions have been reconciled by appropriate interpretation issued by the Architect.
- C. 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 Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject or item.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. 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.
- D. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- E. RFI Submission Procedure:
1. Post electronic submittals as PDF electronic files directly to the Contractor's PIMS as described below.
- F. Architect's Action: Architect will review each RFI, determine action required, and respond as indicated in the project General Conditions. Allow seven working days for Architect's response for each RFI.

1. RFIs received by Architect after 1:00 p.m. in Architect's time zone will be considered as received the following working day.
 2. Where the due date for an action or response occurs on a Saturday, Sunday, or legal holiday, such action or response shall be considered due on the next day that is not a Saturday, Sunday, or legal holiday.
 3. The following RFIs will be returned without action:
 - a. RFIs addressing more than one subject or item.
 - b. Requests for approval of submittals.
 - c. Requests for approval of substitutions.
 - d. Requests for approval of Contractor's means and methods.
 - e. Requests for approval of nonconforming Work.
 - f. Requests for coordination information already indicated in the Contract Documents.
 - g. Requests for adjustments in the Contract Time or the Contract Sum.
 - h. Requests for interpretation of Architect's actions on submittals.
 - i. Incomplete RFIs or inaccurately prepared RFIs.
 4. Architect's action may include a request for additional information, in which case Architect's time for response will begin at the time of receipt by Architect of additional information.
 5. RFIs involving requests for recommendations or design assistance on how to address remediation or correction of nonconforming work are not eligible for an increase in Contract Sum or an extension of Contract Time, regardless of when the RFIs are returned, or the corrective action proposed therein.
 6. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 - Contract Modification Procedures.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
 - 1) If Contractor's notification is submitted more than 21 days after receipt of the RFI response, any work resulting from the RFI response is not eligible for an increase in Contract Sum or an extension of Contract Time.
 7. In the event Contractor requests an accelerated RFI review and response by Architect, Architect will endeavor to accommodate Contractor's request. However, any such desired accelerated review times shall not supersede the requirements of the Contract, and no extension of Contract Time will be authorized because of Architect's failure or inability to adhere to Contractor's desired accelerated review times.
 8. Architect will return a response to the RFI via the PIMS.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:

1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date the RFI response is due.
 8. List of parties the RFI was distributed to.
 9. Date Architect's response was received.
 10. Date the RFI was closed by the Contractor.
 11. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- H. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.7 DIGITAL PROJECT INFORMATION MANAGEMENT

- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
- B. Web-Based Project Information System (PIMS): Provide, administer, and use web-based Project software for purposes of hosting and managing Project communication and documentation until Final Completion.
1. PIMS shall be similar to Procore, Ebuilder, Autodesk Construction Cloud or Plangrid but shall include, at a minimum, the following features:
 - a. Project Directory, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.

- d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
 - m. Creating and exporting editable logs for all PIMS functions including, but not limited to: RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders. Owner, Architect and Architect's Consultants shall have rights and ability to download logs at any time.
2. Provide up to 20 user licenses for use of Owner, Owner's Commissioning Authority, Architect, and Architect's Consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
 3. At completion of Project, change of PIMS or end of Owner-Contractor Contract, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and time a minimum of 3 days prior to the meeting date.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees using PIMS.

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes using PIMS to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, Architect's consultants, Contractor, Contractor's 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: Discuss items of significance that could affect progress, including but not limited to the following:
 - a. Tentative construction schedule.
 - b. Critical work sequencing and long-lead items.
 - c. Designation of key personnel and their duties.
 - d. Lines of communications.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Digital Execution Plan and associated procedures.
 - l. Preparation of record documents.
 - m. Use of the premises existing building.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Parking availability.
 - u. Office, work, and storage areas.
 - v. Equipment deliveries and priorities.
 - w. First aid.
 - x. Security.
 - y. Progress cleaning.

- z. Special procedural, inspection and submittal requirements of the Authorities Having Jurisdiction.
 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes using PIMS.
- C. Digital Execution Conference: schedule and conduct a digital execution conference before starting construction, at a time convenient to Owner Architect, and Contractor.
 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, Architect's consultants, Contractor, Contractor's superintendent, major subcontractors, suppliers, and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect the exchange of digital information, including but not limited to the following:
 - a. Electronic file transfer requirements and protocols.
 - b. Right of reliance on Architect's and Architect's Consultants digital files.
 - c. Schedule of digital file transfers and periodic updates.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes using PIMS.
- D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity as indicated in individual Sections.
 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Owner's Commissioning Authority of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.

- l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information using PIMS.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
 - E. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Architect, Architect's consultants, Contractor, Contractor's superintendent, major subcontractors, suppliers, and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including but not limited to the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.

- f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Owner's partial occupancy requirements.
 - k. Installation of Owner's furniture, fixtures, and equipment.
 - l. Responsibility for removing temporary facilities and controls.
 - m. Close of PIMS and export of data to Owner and Architect.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes using PIMS.
- F. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, and Architect each Contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.

- 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of proposal requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information using PIMS.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 06
COORDINATION DRAWINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative provisions for preparation and submittal of Coordination Drawings and Layout Drawings.

1.2 RELATED REQUIREMENTS

- A. Section 01 31 00 - Project Management and Coordination for general project coordination procedures.
- B. Section 01 33 00 - Submittal Procedures for administrative and procedural requirements for submittals.

1.3 COORDINATION

- A. 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.
- B. Coordinate scheduling and timing of preparation of Coordination Drawings and Layout Drawings with other construction activities to avoid conflicts and to ensure orderly progress of the Work.
- C. In event of conflicts involving location and layout of work; use following priority to resolve conflicts:
 - 1. Structure and partitions have highest priority.
 - 2. Equipment location and access.
 - 3. Ceiling system and recessed light fixtures.
 - 4. Gravity drainage lines.
 - 5. High pressure ductwork and devices.
 - 6. Large pipe mains, valves, and devices.
 - 7. Low pressure ductwork, diffusers, registers, grilles, HVAC equipment.
 - 8. Fire protection piping, devices, and heads.
 - 9. Small piping, tubing, electrical conduit, and devices.
 - 10. Sleeves through fire-resistance-rated partitions.

11. Access panels.

1.4 PROVISION AND USE OF DIGITAL DATA FILES

- A. Digital Data Files: Electronic drawing/model (digital data) files of the Contract Drawings will not be furnished by Architect for Contractor's use in preparing Coordination Drawings and Layout Drawings unless procedures stated within Section 01 33 00 - Submittal Procedures are agreed to, the Contractor executes the Electronic File Transfer Agreement (EFTA) form, and the Contractor properly prepares and submits the Submittals Schedule as indicated in Section 01 32 00 - Construction Progress Documentation.
- B. Release of digital data files are conditional upon the following:
 1. The digital data represented in the files are not Contract Documents.
 2. Only one set of digital data files will be furnished; Contractor assumes responsibility for distributing pertinent files to the various subcontractors.
 3. The digital data files have been developed without the assistance or specific expertise of the individual subcontractors and installers, and therefore do not account for or incorporate means, methods, shop standards, and routing economies required by individual subcontractors for the scope of work required by the finished Work.
 4. Modifications to the information and routings of the selected components shown on the digital data files may be required and are the responsibility of the Contractor. All modifications are part of the scope of Work of this Project and shall be provided at no additional cost to Owner.
 5. Contractor and subcontractors agree that digital data files are not fit for any particular purpose, including, but not limited to quantity take-offs, pricing, development of a building information model (BIM), dimensional control, clash detection, construction sequencing, or the manufacture of any building component or system.
 6. Architect makes no assurances that the digital data files will be usable by the Contractor's and subcontractors' systems, infrastructure, or software; and that the files may be subject to anomalies, errors, viruses, malware, or other unintended defects.
- C. Limitations of Electronic Drawing File Transfer Agreement (EFTA):
 1. Agreement Form applies to procurement of Architectural digital data files only. If Contractor desires digital data files for Drawings prepared by one of Architect's consultants, Contractor may contact consultant directly to obtain such files.

2. Contractor shall recognize that various consultants retained by the Architect for this Project, or retained separately by the Owner, may have agreements that differ from that included in the EFTA, and may have differing costs and procedures involved with obtaining digital data files.
3. Architect makes no assertion that the Architect's or Owner's consultants will furnish digital data files of their Drawings. Additionally, not all Drawings or documents may be available electronically.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Electronic files, prepared in either two-dimensional or three-dimensional format at the Contractor's option, and as applicable to the Work being coordinated.
- B. Layout Drawings: Electronic files, prepared in either two-dimensional or three-dimensional format at the Contractor's option, and as applicable to the Work being located.

1.6 QUALITY ASSURANCE

- A. Prior to Start of Work: Require written approval of Coordination Drawings from each subcontractor whose work is contained within the scope of, or is affected by, the Work for which the Coordination Drawings have been prepared.
- B. Coordination Meetings: Schedule with affected trades and subcontractors. Refer to Section 01 31 00 - Project Management and Coordination.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Coordination Drawings: Reproducible overlay, or three-dimensional drawings showing work with horizontal and vertical dimensions demonstrating layout of the Work to avoid interference with structural framing, ceilings, partitions, equipment, conveying systems, fire suppression systems, plumbing systems, mechanical systems, electrical systems, lighting, fire alarm systems, telecommunications and A/V systems, electronic safety and security systems, and other services scheduled to be installed in congested or concealed spaces.
- B. Coordination Drawings: Provide for the following items of work:
 1. Where required by individual specification Sections.
 2. Where installation is not completely shown on Shop Drawings.

3. Where coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 4. Where limited space availability necessitates coordination, including the following areas and spaces:
 - a. In and above ceilings.
 - b. In soffits and furr-downs.
 - c. In insulation space above structural wood decking.
 - d. Within walls.
 - e. Within chases.
 - f. In mechanical spaces.
 - g. In electrical spaces.
- C. Sleeve, Core Drill, and Block-out Layout Drawings: Reproducible overlay or three-dimensional drawings showing proposed locations and sizes of sleeves, core drills, block-outs, and embedded items in concrete walls, columns, floors, and beams.
1. Refer to fire protection, plumbing, HVAC, electrical, and other facility systems Drawings for items penetrating floor, roof, and structural systems.
 - a. Unless otherwise indicated, sleeves shall be provided for all utility and service (Divisions 21 through 28) items scheduled to traverse vertically through the building structure or penetrate structural members, whether or not sleeves have been specifically shown.
 2. Core-drilling through structural members, as a substitute for proper layout, coordination, and installation of sleeves, will not be permitted.

PART 3 EXECUTION

3.1 COORDINATION DRAWINGS

- A. General: Prepare Coordination Drawings according to requirements in individual Sections, and additionally 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 and most current version of the Contract 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 Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. 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.
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-resistance-rated enclosures around ductwork.
- 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Reflected Ceiling Plans: Light fixtures, exit lights, emergency battery packs, smoke detectors, fire alarm, and A/V system speakers.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. For conduit 1-1/4 inches (32 mm) in diameter and larger, show 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.
 - b. Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire alarm, A/V, and electrical Work. Show locations of visible ceiling-mounted devices relative to sprinkler heads in acoustical ceiling system grid.

3.2 LAYOUT DRAWINGS

- A. Sleeve, Core Drill, and Block-out Layout Drawings: Reproducible overlay drawings showing proposed locations and sizes of sleeves, core drills, block-outs, and embedded items in concrete walls, columns, floors, and beams.
 - 1. 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.
 - 2. Structural Penetrations: Indicate penetrations and openings required for all disciplines. Refer to fire protection, plumbing, HVAC, electrical, and other systems drawings for items penetrating floor, roof, and structural systems.
 - 3. Core-drilling through structural members, as a substitute for proper layout and installation of sleeves, will not be permitted.
- B. Indicate sleeves for utilities and services scheduled to traverse building structure or penetrate structural members. Indicate size of penetrating item, and size of corresponding sleeve.
 - 1. Call specific attention to Divisions 21 through 28 utilities and services that have been relocated from position originally indicated in Contract Documents, and the reason for such relocation.

2. Call specific attention to areas where concrete reinforcing or other structural members may require modification in order to accommodate sleeve or block-out.
- C. Indicate areas where access panels are required to gain access to serviceable and maintenance items.

3.3 COORDINATION AND LAYOUT DRAWING FORMAT

- A. General: Prepare Coordination Drawing and Layout Drawings according to requirements in Section 01 33 00 - Submittal Procedures.
 1. Electronic Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - a. File Submittal Format: Submit or post coordination drawing files using PDF format.
 - b. Perform three-dimensional component conflict analysis as part of preparation of Coordination Drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 2. Show architectural and structural elements with which the various facility services and systems must be coordinated, including the following:
 - a. Partitions.
 - b. Ceiling heights.
 - c. Structural framing locations and elevations.
 - d. Column lines.
 - e. Other impediments and interferences with installation of the Work.
 3. Show locations of the various facility services and systems, horizontally dimensioned from column center lines, and vertically dimensioned from top of floor slab elevations.
- B. Produce combined Coordination and Layout Drawing plans and sections that fully integrate the various fire suppression systems, plumbing systems, HVAC systems, electrical systems, communications systems, electronic safety and security systems, equipment, and other work.
 1. Systems shall be uniquely color-coded for ease of identification.
- C. Prepare Drawings for coordination of installation of products and materials fabricated by separate entities.
 1. Indicate relationship of components shown on separate Shop Drawings.
 2. Indicate required installation sequences.

3. Refer to Divisions 21 through 28 for specific Coordination Drawing requirements for facility services installations.

3.4 CONTRACTOR'S ACTION

- A. Produce initial Coordination Drawings within 45 days after initial coordination meeting.
- B. Resolve major interferences at initial coordination meeting prior to production of drawings.
- C. After written approval of Coordination Drawings and Layout Drawings by each affected subcontractor, determine method used to resolve interferences not previously identified.
- D. Give written approval of acceptable changes to Coordination Drawings and Layout Drawings prior to start of work in affected area.
- E. Review Coordination Drawings and Layout Drawings and check for compliance with the Contract Documents. Note corrections, adjustments, and field dimensions. Mark with approval stamp before submitting to Architect.
- F. Distribution: Furnish copies of final Coordination Drawings and Layout Drawings to manufacturers, subcontractors, suppliers, fabricators, installers, and others as necessary for performance of construction activities.
- G. Use for Construction: Retain complete copies of Coordination Drawings and Layout Drawings on Project site and maintain copy in field office at Project Site.

3.5 ARCHITECT'S ACTION

- A. Review: Architect will review Coordination Drawings and Layout Drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which remain the Contractor's responsibility. If Architect determines that Coordination Drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

3.6 ADJUSTING

- A. At no additional cost to the Owner, make the necessary modifications or adjustments required to the Work as a result of the following:

1. Failure to provide complete or correct Coordination Drawings or Layout Drawings for those items of Work.
 2. Failure to avoid or resolve conflicts or interferences prior to installation of the Work.
 3. Failure to call attention to changes that may be required to adjacent or subsequent Work made necessary as a result of modifications.
- B. Core-drilling and other remedial work resulting from missing or mislocated sleeves shall be provided at no additional cost to Owner.
1. In the event core-drilling severs reinforcing or otherwise weakens the structure, provide additional reinforcing and support as required, as determined by the Structural Engineer, to restore the structure's originally designed load-carrying capability.

END OF SECTION

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's construction schedule.
 - 2. Construction schedule updating reports.
 - 3. Reports:
 - a. Daily construction reports.
 - b. Material location reports.
 - c. Site condition reports.
 - d. Special reports.

1.2 RELATED REQUIREMENTS:

- A. Section 01 29 00 - Payment Procedures for submitting the Schedule of Values.
- B. Section 01 31 00 - Project Management and Coordination for submitting and distributing meeting and conference minutes.
- C. Section 01 32 33 - Photographic Documentation for submitting construction photographs.
- D. Section 01 33 00 - Submittal Procedures for submitting schedules and reports.
- E. Section 01 40 00 - Quality Requirements for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.

3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Major Area: A story of construction, a separate building, a separate wing, a major department, or a similar significant construction element.
- G. Milestone: A key or critical point in time for reference or measurement.
- H. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.4 INFORMATIONAL SUBMITTALS

- A. Submittals Format: Reference Section 01 33 00 - Submittal Procedures for requirements.
- B. Submittal Schedule: Arrange the following information in a tabular format:
 1. Specification Section number and title.
 2. Submittal category (action or informational).
 3. Name of subcontractor.
 4. Description of the Work covered.
 5. Scheduled date for first submittal.
 6. Date of submission.
 7. Scheduled date for Architect and Owner's final release or approval.
 8. Fabrication and delivery time frame.

9. Required on job date.
 10. Approval date.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working electronic copy of schedule. Include type of schedule (initial or updated) and date on label.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 3. Total Float Report: List of activities sorted in ascending order of total float.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Material Location Reports: Submit as required with monthly payment application.
- H. Site Condition Reports: Submit immediately at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 - Project Management and Coordination. Review methods and procedures related to Contractor's construction schedule, including, but not limited to, the following:
1. Review format for reports.
 2. Verify availability of qualified personnel needed to develop and update schedule.
 3. Discuss constraints, including phasing, work stages, area separations, interim milestones, and partial Owner occupancy.
 4. Review delivery dates for Owner-furnished products.
 5. Review schedule for work of Owner's separate contracts.

6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's construction schedule with the submittal schedule, progress reports, 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

2.1 SUBMITTAL SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for initial review, at least one resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 1. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.
- B. Restrictions and Limitations:
 1. Submittal review and processing times listed in Section 01 33 00 - Submittal Procedures shall be considered baselines and shall take precedence over any lesser times promulgated by Contractor in the Submittal Schedule or Construction Schedule.
 2. No delay claim will be entertained, and no extension of the Contract Time will be authorized due to Contractor's failure to transmit submittals enough in advance of the Work to permit proper and reasonable processing.

3. If the Contractor fails to submit a Submittal Schedule or fails to provide submittals in accordance with the approved Submittal Schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion and final completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an earlier or later completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
 2. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect and Owner.
 3. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 4. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 - Submittal Procedures in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 5. Startup and Testing Time: Include time as required by Owner for startup and testing. Startup and Testing must be completed by Substantial Completion.
 6. Substantial Completion: Indicate date established for Substantial Completion. Allow time for Architect and Owner's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include time as required by Owner for completion of punch list items and final completion.
 8. 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.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.

1. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 - Summary. Delivery dates indicated stipulate the earliest possible delivery date.
 3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 - Summary. Delivery dates indicated stipulate the earliest possible delivery date.
 4. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 5. 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.
 6. 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.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Upcoming Work Summary/Look-Ahead Schedule: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.

2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using the Critical Path Method.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect and Owner's approval of the schedule.
 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
- D. CPM Schedule Preparation: Prepare a list of activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

- a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
2. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
- E. Contract Modifications: For each proposed contract modification, if applicable 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 diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.

7. Changes in the Contract Time.

2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (see 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.
 20. Construction photographs with descriptions.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.

- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information in accordance with RFI provisions of Section 01 31 00 - Project Management and Coordination. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day(s) 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 immediately. 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

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule with application for payment.
 - 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.
- B. Distribution: Distribute copies of approved schedule to Architect and Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

END OF SECTION

SECTION 01 32 33

PHOTOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for the following:
 - 1. Construction photographs.
 - 2. Construction video recordings.

1.2 RELATED REQUIREMENTS:

- A. Section 01 33 00 - Submittal Procedures for submitting photographic documentation.
- B. Section 01 77 00 - Closeout Procedures for submitting photographic documentation as project record documents at Project closeout.
- C. Section 01 79 00 - Demonstration and Training for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Construction photographs may not be used for Contractor's marketing materials or social media unless approved by Owner.

1.4 INFORMATIONAL SUBMITTALS

- A. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos electronically. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name of Contractor.
 - c. Date photograph was taken.
 - d. Description of location, vantage point, and direction.
 - e. Unique sequential identifier keyed to accompanying key plan.

- B. Video Recordings: Submit video recordings within seven days of recording.
 - 1. Submit video recordings electronically. Include copy of key plan indicating each video's location and direction.
 - 2. Identification: With each submittal, provide the following information in file metadata tag:
 - a. Name of Project.
 - b. Name of Contractor.
 - c. Date video recording was recorded.
 - d. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.5 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format. Photographs should be clear, free from obstruction with appropriate lighting, and easily viewable.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1.6 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of the Work, 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 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take 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.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work.

- D. Periodic Construction Photographs: Take photographs at weekly intervals 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. Final Completion Construction Photographs: Take photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.
- F. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.

1.7 CONSTRUCTION VIDEO RECORDINGS

- A. Preconstruction Video Recording: Before starting demolition and construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Architect.
 - 1. Flag construction limits before recording construction video recordings.
 - 2. Show existing conditions adjacent to Project site before starting the Work.
 - 3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of demolition and construction.
 - 4. Show protection efforts by Contractor.
- B. Periodic Construction Video Recordings: Record video recording monthly and coinciding with the cutoff date associated with each Application for payment. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time shall be 30 minutes(s).

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED REQUIREMENTS:

- A. Section 01 29 00 - Payment Procedures for submitting Applications for Payment and the Schedule of Values.
- B. Section 01 31 00 - Project Management and Coordination; for submitting RFIs, issuing meeting minutes, and submitting Coordination Drawings requirements.
- C. Section 01 31 06 - Coordination Drawings for coordination drawing requirements.
- D. Section 01 32 00 - Construction Progress Documentation for submitting schedules and reports, including Contractor's Construction Schedule.
- E. Section 01 32 33 - Photographic Documentation for submitting construction photographs.
- F. Section 01 40 00 - Quality Requirements for submitting test and inspection reports.
- G. Section 01 77 00 - Closeout Procedures for submitting warranties.
- H. Section 01 78 23 - Operation and Maintenance Data for submitting operation and maintenance manuals.
- I. Section 01 78 39 - Project Record Documents for submitting record Drawings, record Specifications, and record Product Data.
- J. Section 01 79 00 - Demonstration and Training for submitting video recordings of demonstration of equipment and training of Owner's personnel.
- K. Division 02 – 33 Specification Sections for submittal requirements specific to the Sections.

1.3 DEFINITIONS

- A. Submittals: Written and graphic information and physical samples sent to the for confirmation of the Project design.
- B. Project Information Management System (PIMS): Web-based Project Information Management System managed by the Contractor and for use by Owner, Owner's Consultants, Architect and Architect's Consultants.
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. 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 submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Resubmittal Review: Allow 10 business days for review of each resubmittal.

- C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with a unique identifier:
 - a. Specification number with no spaces followed by a period.
 - b. Three-digit sequential number followed by a period.
 - c. Two-digit revision number followed by a dash. An initial submittal will use 00 for the revision number.
 - d. Two-character Type Identifier followed by a dash.
 - 1) CT for certificate.
 - 2) IN for informational submittal.
 - 3) PD for product data.
 - 4) QL for qualification information.
 - 5) SA for samples.
 - 6) SD for shop drawing.
 - 7) TR for test report.
 - e. Short description of the content, using material designation indicated in the Contract Documents where present.
 - f. Example: 084413.001.00-SD-Curtain Wall CW-1.pdf
 3. Use submittal schedule to permanently record Contractor's review and approval markings and action taken by Architect and Owner.
 4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner.
- D. Options: Identify options requiring selection by the Architect and Owner.
- E. Deviations: Identify deviations from the Contract Documents on submittals.
1. Clearly identify deviations from the Contract Documents by clouding or other suitable means acceptable to Architect and Owner.
 - a. Provide accompanying detailed written explanation for each deviation.
 - b. Provide the corresponding specification Section labeled with compliance and non-compliance.
- F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

- G. 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.
- H. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

PART 2 PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit electronic submittals to Architect and Owner using PIMS.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - 3. Test and Inspection Reports Submittals: Comply with requirements specified in Section 01 40 00 - 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. Equipment dimensional drawings.
 - b. Wiring diagrams showing factory-installed wiring.
 - c. Printed performance curves.
 - d. Operational range diagrams.
 - e. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data concurrent with Samples.
 - C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based upon Architect's digital data drawing files is otherwise permitted.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 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.
 3. Number and title of applicable Specification Section.
 4. Number of Samples: Submit samples as required in individual Specification Sections.
 5. Disposition: When possible, 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 responsibility of Contractor.
- E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 - Project Management and Coordination.
- F. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 - Construction Progress Documentation.
- G. Application for Payment: Comply with requirements specified in Section 01 29 00 - Payment Procedures.
- H. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- I. 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.
- J. 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.
- K. 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.
- L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- N. 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.

- O. 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.
- P. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- Q. 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.
- R. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- S. Maintenance Data: Comply with requirements specified in Section 01 78 23 - Operation and Maintenance Data.
- T. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic filesigned and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. Provide delegated-design drawings to Owner in electronic format.

PART 3 EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Section 01 77 00 - Closeout Procedures.
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. Final Unrestricted Release: When the Architect marks a submittal:
 - a. A - NO EXCEPTIONS
 - b. The Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
 - 2. Final-But-Restricted Release: When the Architect marks a submittal:
 - a. B - EXCEPTIONS AS NOTED

- b. The Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance. Resubmittal is not required for this action.
 3. Returned for Resubmittal: When the Architect marks a submittal:
 - a. C – REVISE AND RESUBMIT
 - b. Do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 - c. Do not use, or allow others to use, submittals marked "C- REVISE AND RESUBMIT" at the Project Site or elsewhere where Work is in progress.
 4. Returned as Rejected: When the Architect marks a submittal:
 - a. D – REJECTED
 - b. Do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. The submittal does not conform to the design concept or meet requirements of the Contract Documents.
 - c. Do not use, or allow others to use, submittals marked "D – REJECTED" at the Project Site or elsewhere where Work is in progress.
 5. Returned as received for Information Only: When the Architect marks a submittal:
 - a. E – FOR INFORMATION ONLY
 - b. Proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. The submittal is acceptable, but the Architect's affirmative action is not required.
 6. Returned as Not Reviewed: When the Architect marks a submittal:
 - a. F - NOT REVIEWED
 - b. Submittal is not required by the Contract Documents.
- B. Submittals are reviewed for conformance with the design concept expressed in the Contract Documents. Review is not for the purpose of confirming or approving:
 1. Deviation from the Contract Documents, including but not limited to deviation with reference to material, quantity, location, quality, dimension, or orientation (except as expressly annotated in writing by the Architect herein).
 2. Means, methods, sequences, or techniques of construction (unless expressly called for in the Contract Documents and herein expressly highlighted for review and approval by the Architect).
 3. Safety of the Contractor(s) work, work plan, procedures, workers or of the site.
 4. Any clarification of a patent or latent ambiguity or defect in the Contract Documents.

5. Procurement or request for any labor, materials or other expense of the contractor(s) which is in addition to that previously approved by the Owner.
- C. Contractor shall be and shall remain responsible for:
1. Compliance with the Contract Documents.
 2. Coordination of the Work (including amongst various trades).
 3. Performing the Work in a safe and satisfactory manner.
 4. Confirming and correlating quantity and dimensions, and
 5. Construction schedule.
- D. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- E. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- F. Incomplete submittals are not acceptable, will be considered non-responsive, and will be returned without review.
- G. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.3 ATTACHMENTS

- A. Appendix A – Electronic Drawing File Transfer Agreement Form.

END OF SECTION

Perkins&Will

Electronic File Transfer Agreement (Third Party – CAD Files)

Name		Date:	
Address		Project Name:	Oakton College Tenhoeve Fit Out
Description of Data:	Architectural CAD File	Project No:	

The *undersigned* is not a party to an agreement for professional services provided by Perkins and Will, by itself or through its employees and officers, but has been engaged as an outside consultant (the “Consultant”) by the Owner to perform ancillary consulting services and for use in preparation of documents related to the above-referenced Project (hereinafter the “**Project**”), subject to these terms and conditions. The undersigned hereby requests that Perkins and Will, and its consultants if applicable, provide graphic drawing information prepared by Perkins and Will and its consultants for the Project in the form of Electronic Files. The *undersigned* acknowledges and agrees that Perkins and Will has no contractual obligation to provide the Electronic Files to the “Consultant”. Perkins and Will agrees to provide the Electronic Files, however, in consideration for the undertakings of the undersigned herein.

Electronic Files to be furnished include work prepared by the Architect only but may – in certain circumstances – also include Files for work prepared by the M-E-P consultant and structural consultant. Electronic Files will be furnished in .dwf file format only. Only one set of Electronic Files will be furnished; Consultant assumes responsibility for distributing pertinent files to the Consultant’s employees and various sub-consultants.

The *undersigned* agrees that the request to provide the Electronic Files is purely for the convenience of the Consultant and does not constitute the rendering of professional services. Whereas Perkins and Will has prepared the Electronic Files to facilitate the production of Deliverables, which are reasonably accurate and complete to the extent of the standard of professional care applicable to the Deliverables, the *undersigned* acknowledges that Perkins and Will has not and will not otherwise review the furnished Electronic Files to determine if they are accurate or complete, are suitable for the Consultant’s purpose, or if they identify or contain any issue, anomaly, omission, or concern with reference to the **Project**.

The ***undersigned*** agrees and understands that the Electronic Files, except as expressly set forth above, are not fit for any particular purpose, including, but not limited to quantity take-offs; pricing; clash detection; ascertainment of construction or installation tolerances and clearances; preparation of shop drawings, coordination drawings, or fabrication drawings; construction sequencing; or the manufacture of any building component or system. As such, the Electronic Files, or the information contained therein or which may have been omitted there from with respect to the content of the Contract Documents, shall not be used as a basis for a claim against the Architect or any of its consultants.

The ***undersigned*** acknowledges that the Electronic Files have been developed without the assistance or specific expertise of the individual sub-consultants and installers, and therefore do not account for or incorporate means, methods, shop standards, and routing economies required by individual sub-Consultants for the scope of work required by the finished Work. Modifications to the information and routings of the selected components included in the Electronic Files may be required and are the responsibility of the Consultant to ascertain, coordinate, and implement.

The ***undersigned*** further acknowledges that Perkins and Will has made no representations to the undersigned that the Electronic Files are suitable for any purpose other than as expressly set forth above, or will be usable by the ***undersigned's*** systems, infrastructure, or software. The ***undersigned*** also understands and agrees that the Electronic Files may be subject to anomalies, errors, viruses, malware, or other unintended defects, and that Perkins and Will has not reviewed or determined whether or not any such defects may be present in any Electronic Files. Use of these Electronic Files is solely at the risk of the ***undersigned***.

The ***undersigned*** agrees to release any and all claims that they may have at any time against Perkins and Will and its consultants arising out of the use of the Electronic Files by the ***undersigned*** or any other individual or entity. The ***undersigned*** agrees to hold harmless and indemnify Perkins and Will and their consultants from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the provision of the Electronic Files by Perkins and Will or the use, modification, misinterpretation, misuse, or reuse by others of the Electronic Files provided by Perkins and Will. The ***undersigned*** shall not use, modify or reproduce any of the Electronic Files without first removing any identifying information, if any, for Perkins and Will and their consultants, on the files or incorporated in or into the Files.

The ***undersigned*** confirms that it will only use the Electronic Files with reference to the **Project** and shall not permit the Files to be copied or distributed, except for use on this **Project**.

Upon return receipt of this signed Agreement the Electronic Files will be transmitted to the ***undersigned*** via courier, electronic mail, or posted on the Perkins and Will file transfer protocol site or project web site.

This Agreement may be executed in counterpart, and the parties agree that the individual counterparts, taken together, shall constitute a binding agreement.

The ***undersigned*** agrees that they are authorized to bind the company indicated below to the obligations of this Agreement and understands that Perkins and Will is relying upon this representation in agreeing to enter into this Agreement. In addition to any rights that Perkins and Will may have against the company, the ***undersigned*** agrees that Perkins and Will shall have rights personally against the ***undersigned*** if this apparent authority is questioned or disputed by the company in any way.

The **undersigned** agrees that any violation of this Agreement by the **undersigned** or the company, or any of the agents, representatives, officers or employees of either will result in irreparable harm to Perkins and Will which cannot be entirely compensated via money damages. Therefore, the **undersigned** and the company agree that Perkins and Will may seek any and all equitable remedies that may be available to Perkins and Will, including, but not limited to a temporary or permanent injunction in the event of any breach or threatened breach of the terms of this Agreement.

The **undersigned** shall reimburse Perkins and Will for any cost or expense, including attorney's fees, labor and expenses (including those of in-house counsel) related to the enforcement of the terms of this Agreement.

ACKNOWLEDGED AND ACCEPTED:

Third Party (*The Consultant*)

Third Party:

Printed Name

Signature of Recipient

Title

Company

Date

END OF AGREEMENT

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED REQUIREMENTS

- A. Section 01 21 00 - Allowances for testing and inspection allowances.
- B. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.3 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 Architect.

- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- D. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. 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(s).
- H. 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.

1.4 CONFLICTING REQUIREMENTS

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

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

1.5 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
- C. 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.
- D. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

- A. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, telephone number, and email address of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement of whether conditions, products, and installation will affect warranty.

7. Other required items indicated in individual Specification Sections.
- B. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- C. 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.

1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, 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. Where required by individual Specification Sections, Installer employing workers trained and approved by manufacturer, Installer being acceptable to manufacturer, and/or Installer being an authorized representative of manufacturer for both installation and maintenance.

- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
 - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. 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.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 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. When testing is complete, remove assemblies; do not reuse materials on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, 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.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. 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 inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 - Submittal Procedures.

- 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 preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. **Retesting/Reinspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. **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.
- G. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. **Schedule of Tests and Inspections:** Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. **Distribution:** Distribute schedule to Owner, Architect, and testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
 - 1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 - Execution.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 42 00

REFERENCES

PART 1 GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract, without any implied meaning extending the Architect's responsibility into the Contractor's area of Contractor coordination, supervision, or means and methods of construction as outlined in the Conditions of the Contract.
 - 1. In no situation will an approval by Architect release Contractor from responsibility to fulfill requirements of the Contract Documents.
- C. "Authorities Having Jurisdiction" (AHJ): Means the agencies, either individually or collectively, charged by statute with administration and enforcement of the requirements of building codes and other regulations at the Project location.
- D. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- E. "General Requirements":
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions (if any) and other Division 01 General Requirement Sections, apply to all sections of the work.
 - 2. The provisions or requirements of Division 01 Sections apply to entire Work of the Contract and where so indicated, to other elements which are included in the Project.
- F. "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."
- G. "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.

REFERENCES

- H. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- I. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- J. "Provide": Furnish and install, complete and ready for the intended use.
- K. "Installer": Means the Contractor or other entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor to perform a particular construction operation at the Project site, including preparation, erection, installation, application, construction, re-installation, and similar operations required for execution of the Work.
 - 1. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
 - 2. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.
- L. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

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

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

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Conflicting Requirements: Where 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 uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
 1. 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.
 2. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to Architect for a decision before proceeding.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for temporary utilities, support facilities, and security and protection of facilities.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary for work restrictions and limitations on utility interruptions.

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 construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. 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, backflow preventers, and extensions of services as required for construction operations.
- C. 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 SUBMITTALS

- A. Informational Submittals:
 - 1. Implementation and Termination Schedule: Within 15 days of date established from commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

2. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
3. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
4. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- 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:
 - a. Locations of dust-control partitions at each phase of work.
 - b. HVAC system isolation schematic drawing.
 - c. Location of proposed air-filtration system discharge.
 - d. Waste handling procedures.
 - e. Other dust-control measures.
5. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
 - a. Methods used to meet the goals and requirements of the Owner.
 - b. Concrete cutting method(s) to be used.
 - c. Location of construction devices on the site.
 - d. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 - e. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
 - f. Indicate Locations of sensitive equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

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. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, State Accessibility Code, Local Accessibility Code, and ICC/ANSI A117.1.

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. Lumber and Plywood: Comply with requirements in Section 06 10 53 - Miscellaneous Carpentry.
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1624 mm).
- D. Paint: Comply with requirements in Section 09 91 00 - Painting.
- E. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- 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 qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.

3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 77 00 Closeout Procedures.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.
- D. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 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 Section 01 10 00 - 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.

3.3 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. 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.
- C. 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 according to 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.
- D. 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.
- E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- F. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.

1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
 2. Provide warning signs at power outlets other than 110 to 120 V.
 3. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
 4. Provide metal conduit enclosures or boxes for wiring devices.
 5. Provide 4-gang outlets, spaced so 100-foot (30-m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Install lighting for Project identification sign.
- H. Electronic Communication (E-mail) Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.
1. Provide broadband in primary field office.
 2. Provide for connection of communication devices Owner, Architect and Contractor by Wi-Fi, or wired connections.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Parking: Provide temporary parking areas for construction personnel.
- B. 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.

- C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 - Execution.
- D. 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.
- E. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- F. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction 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 Section 01 10 00 - Summary.
- C. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Coordinate and provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- E. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- F. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 - 2. Construct dustproof partitions with two layers of 6-mil (0.14-mm) polyethylene sheet on each side. Cover floor with two layers of 6-mil (0.14-mm) polyethylene sheet, extending sheets 18 inches (460 mm) 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 (1219 mm) 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.

- G. Temporary Fire-Rated Partitions: Erect and maintain dustproof fire-rated partitions and temporary enclosures to limit dust and dirt migration and to separate occupied areas from construction, fumes, and noise. Fire-rated partitions shall be provided to separate existing occupied areas from construction areas in accordance with NFPA 241
1. Construct fire-rated dustproof partitions of not less than nominal 4-inch (100-mm) studs, 1/2-inch (13-mm) or 5/8-inch (16 mm) Type X gypsum wallboard on both sides, with joints taped.
 2. Extend partitions up to underside of existing structure to the greatest extent possible.
 3. Insulate partitions to provide noise protection to occupied areas.
 4. Seal joints and perimeter with fire-resistant joint sealant.
 5. Equip partitions with dustproof doors and security locks.
 - a. Protect openings in 1-hour fire-rated partitions with 45-minute hollow metal or solid core wood doors.
 6. Protect air-handling equipment.
 7. Weatherstrip openings.
- H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
 2. Store combustible materials in containers in fire-safe locations.
 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
 4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
 5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

6. Develop and supervise an overall fire-prevention and first-aid fire-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.
7. Prohibit smoking in construction areas.
8. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
9. 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.
10. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

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

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. 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.

1.2 RELATED REQUIREMENTS

- A. Section 01 21 00 - Allowances for products selected under an allowance.
- B. Section 01 23 00 - Alternates for products selected under an alternate.
- C. Section 01 25 00 - Substitution Procedures for requests for substitutions after bid /pricing.
- D. Section 01 42 00 - References for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. 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 single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of products for purposes of evaluating comparable products.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 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. Identification of basis-of-design product, fabrication, or installation method to be replaced, including Specification Section number and title, and Drawing numbers and titles.

- B. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 - Submittal Procedures. Show compliance with requirements.
- D. Substitution: Refer to Section 01 25 00 - Substitution Procedures for definition and limitations on substitutions.

1.5 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. Each Contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between Contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 COORDINATION

- A. Coordinate affected Work as necessary to integrate work of approved comparable products and approved substitutions.

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

1.8 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. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 - Closeout Procedures.

1.9 PROHIBITION ON INCORPORATION OF HAZARDOUS MATERIALS

- A. Contractor is responsible for ascertaining that materials within the existing facility, which will be disturbed as part of the work, are free of asbestos containing materials and for performing surveys and/or providing certifications attesting regarding this.
- B. Architect and its consultants have not knowingly specified for incorporation into the work, materials or products containing hazardous materials or toxic substances (including asbestos).
- C. Contractor (including its subcontractors, sub-subcontractors, and material suppliers/fabricators under its control) is prohibited from incorporating any material or products into the work containing hazardous materials or toxic substances.
- D. As part of completed materials and products list required herein, Contractor shall assemble, for the Owner's records, the Material Safety Data Sheets (MSDS) for all materials and products incorporated into the work. These MSD sheets shall be updated upon final completion of the work to incorporate changes which have occurred during the course of the work due to approved substitution requests and other modifications. Architect will not review, nor approve, the MSD sheets. The Contractor, also as a pre-requisite to achieving final completion, shall provide a certificate to the Owner indicating that no hazardous or toxic materials or products were incorporated into the work.
- E. Architect and its consultants are not responsible for the presence of hazardous materials or toxic substances in or around the work, nor the exposure to persons who construct or subsequently occupy the work. The Architect will not provide certifications regarding the presence or absence of such materials or substances.

PART 2 PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

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.
 - a. Substitutions may be considered, unless otherwise indicated, when submitted in accordance with provisions of Section 01 25 00 - Substitution Procedures.
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.
 - a. Substitutions may be considered, unless otherwise indicated, when submitted in accordance with provisions of Section 01 25 00 - Substitution Procedures.
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. Nonrestricted 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) Substitutions may be considered, unless otherwise indicated, when submitted in accordance with provisions of Section 01 25 00 - Substitution Procedures.
4. Manufacturers:

- a. 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.
 - b. Nonrestricted 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.
 - 1) Substitutions may be considered, unless otherwise indicated, when submitted in accordance with provisions of Section 01 25 00 - Substitution Procedures.
5. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
6. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer.
 - a. Submitted in accordance with provisions of Section 01 25 00 - Substitution Procedures.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. Substitutions may be considered, unless otherwise indicated, when submitted in accordance with provisions of Section 01 25 00 - Substitution Procedures.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 - Substitution Procedures for proposal of product.

- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
1. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 2. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.
 3. Full Industry Range: Where Specifications include the phrase "full industry range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from any listed manufacturer's product line that includes both standard and premium items.
 4. "Custom Color as selected by Architect" or "to match color on file in Architect's office", "match Architect's sample" means that the color selected is custom and requires custom formulations and submissions of color to obtain Architect's approval prior to application.
- E. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 01 for allowances that control product selection and for procedures required for processing such selections.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and 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.

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4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Submitted in accordance with provisions of Section 01 25 00 - Substitution Procedures.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 73 00

EXECUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Installation of the Work.
 - 2. Coordination of Owner-installed products.
 - 3. Progress cleaning.
 - 4. Starting and adjusting.
 - 5. Protection of installed construction.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary for limits on use of Project site.
- B. Section 01 33 00 - Submittal Procedures for submitting surveys.
- C. Section 01 73 29 - Cutting and Patching.
- D. Section 01 77 00 - Closeout Procedures for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
- E. Section 02 41 19 - Selective Demolition for demolition and removal of selected portions of the building.
- F. Section 07 84 13 - Penetration Firestopping for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examination of the Site and Records of Existing Construction and Conditions: Examine the site, the records of existing construction, and the conditions under which the Work is to be performed. Notify the Architect immediately if existing conditions discovered will affect the Work as shown on the Contract Documents

- B. Existing Conditions Depicted in the Contract Documents: The Contract Documents are based upon the information furnished to the Architect by the Owner. Such information is available from the Owner. The records are furnished for information only and may not represent all conditions that will be encountered. The records of existing construction represent conditions known to the Owner. Other construction, of which no records are available, may be encountered. Dimensions of existing construction are based on information provided to the Architect by the Owner. The Contractor and each subcontractor shall field verify dimensions of existing conditions.
- C. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- D. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- E. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00 - Project Management and Coordination.

3.3 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.
 - 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Precautions Against Movement or Settlement: The Contractor shall take precautions, including bracing, shoring, underpinning, or other retaining structures, to guard against movement or settlement of existing or new construction. Assume responsibility for the design, safety, and support of such construction, and for movement, settlement, damage, or injury resulting from the construction.
- C. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- D. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- E. 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.

- F. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- G. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- H. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- I. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- J. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- K. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 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. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.5 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 days during normal weather or three days if the temperature is expected to rise above 80 deg 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. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- 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 Section 01 50 00 - Temporary Facilities and Controls.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to 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.

3.6 STARTING AND ADJUSTING

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

3.7 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.

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General administrative and procedural requirements for cutting and patching.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.
- C. Cutting and patching is performed for coordination of the Work, to uncover Work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.
- D. Restoring or removing and replacing non-complying work is specified separately from cutting-and-patching but may require cutting-and-patching operations as specified herein.

1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Coordinate with Owner if Cutting and Patching Conference will be required.
 - 2. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
 - 3. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 SUBMITTALS

- A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
1. Coordinate with Owner if Cutting and Patching Plan will be required.
 2. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 3. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 4. Products: List products to be used for patching and firms or entities that will perform patching work.
 5. Dates: Indicate when cutting and patching will be performed.
 6. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.5 QUALITY ASSURANCE

- A. Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Owner and Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Materials to be cut and patched include those damaged by the performance of the Work.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Temporary Support: Provide temporary support of Work to be cut.
- C. Protection: Protect existing 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. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- E. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. 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.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 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, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang 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 weathertight condition and ensures thermal and moisture integrity of building enclosure.
- D. Fire Rated Construction: At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 13 - Penetration Firestopping, to full thickness of the penetrated element.
- E. Roofing: Where penetrations are made through the roof system to accommodate mechanical, electrical, or plumbing systems, or any other reason associated with the Work, repair in accordance with the original manufacturer's requirements. Install curbs, cants, flashing and other roof system components in accordance with Specifications within this Project Manual and recommendations by the manufacturer of the roof system presently in place. Return assembly to weather-tight condition. Also refer to Division 07 Section on roof modifications or repairs.
- F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. 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.
 - 5. Repair of the Work.

1.2 RELATED REQUIREMENTS

- A. Section 01 31 00 - Project Management and Coordination for Web-based Project Information Management System.
- B. Section 01 32 33 - Photographic Documentation for submitting final completion construction photographic documentation.
- C. Section 01 73 00 - Execution for progress cleaning of Project site.
- D. Section 01 78 23 - Operation and Maintenance Data for operation and maintenance manual requirements.
- E. Section 01 78 39 - Project Record Documents for submitting record Drawings, record Specifications, and record Product Data.
- F. Section 01 79 00 - Demonstration and Training for requirements for instructing Owner's personnel.
- G. Divisions 03 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor prepared list of items to be completed or corrected, prepared for the Architect's use prior to Owner, Owner's Agent, and Architect's inspection (Design Team Punchlist), to determine if the Work is substantially complete.

1.4 SUBMITTALS

- A. Action Submittals:

- 1. Product Data: For cleaning agents.
- 2. Contractor's List of Incomplete Items: Initial submittal at time of request for Substantial Completion Inspection.
- 3. Certified List of Incomplete Items: Final submittal at Final Completion.

- B. Closeout Submittals:

- 1. Certificates of Release: From authorities having jurisdiction.
- 2. Certificate of Insurance: For continuing coverage.
- 3. Field Report: For pest control inspection.

- C. Maintenance Material Submittals:

- 1. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. "Substantial Completion" is the stage in the progress of Work when Work or designated portion thereof is sufficiently complete in accordance with Contract Documents so Owner can occupy or utilize Work for use which it is intended.
 - 1. Work will not be considered suitable for Substantial Completion review until all systems and equipment are operational; all designated or required governmental inspections and certifications have been made and posted, designated instruction of Owner's personnel in operation of systems and equipment has been completed, operation and maintenance data has been satisfactorily turned over to the Owner, and all finishes are in place. In general, the only remaining Work shall be minor in nature, such that the Owner could occupy project or designated portion thereof on following day, and completion of Work by Contractor would not materially interfere or hamper Owner's normal business operations.

2. Contractor shall certify that all remaining Work will be completed within a reasonable time, agreed upon by Owner, following date of Substantial Completion. Failure of the Contractor to complete the Work within the stipulated time shall automatically re-institute the provisions for liquidated damages due Owner as contained elsewhere in Contract Documents, or as provided by law for such period of time as may be required by Contractor to fully complete Work whether Owner has occupied the Project or not.
- B. Contractor's List of Incomplete Items: Using Web-based Project Information Management Systems, prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- C. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - a. State accessibility standards inspection.
 - b. Accessibility standard inspection for compliance with ANSI A117.1, Americans with Disabilities Act Accessibility Guidelines (ADAAG) and local requirements if more stringent.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

- D. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 - Demonstration and Training.
 6. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs and photographic negatives, damage or settlement surveys, property surveys, and similar final record information.
 7. Advise Owner of changeover in heat and other utilities.
 8. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 10. Complete final cleaning requirements, including touchup painting.
 11. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- E. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request and the Contractor's list of incomplete items, 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 01 29 00 - Payment Procedures.
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 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 or substantially similar form, and forward to Architect at time of request for Substantial Completion inspection. Architect may use same form for Architect's supplemental items to Contractor.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 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. Architect will return annotated file.

1.8 ACCESSIBILITY STANDARD INSPECTION

- A. Provide inspection at Substantial Completion of facility in accordance with rules and regulations of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) for the purpose of determining compliance with ADAAG. Inspector must be licensed with the state fire marshal to perform the required inspection.
- B. Upon receipt of Inspector's report, immediately make corrections of any reported non-compliant items. Provide documentation to Owner of completed corrective measures.

1.9 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Section 01 78 23 - Operation and Maintenance Data.

1.10 PROJECT RECORD DOCUMENTS

- A. Refer to Section 01 78 39 - Project Record Documents.

1.11 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 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 Project Manual.
 - 1. Warranty Electronic File: 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 bookmarked table of contents at beginning of document.

PART 2 PRODUCTS

2.1 MATERIALS

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

PART 3 EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, 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 broom 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 broom clean in unoccupied spaces.
- i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations 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. Polish mirrors and glass, taking care not to scratch surfaces.
- k. Remove labels that are not permanent.
- l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
- p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- q. Leave Project clean and ready for occupancy.

- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 50 00 - Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. 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. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions 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 Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

1.5 COORDINATION

- A. Where operation and maintenance documentation include information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. 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 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, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 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 Architect.
 - 8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. 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 on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

2.3 EMERGENCY PROCEDURES 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.

2.4 OPERATION AND MAINTENANCE 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 has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- 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.

2.5 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.

2.6 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 (NOT USED)

END OF SECTION

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Digital Data Files.
 - 3. Record Specifications.
 - 4. Record Product Data.
 - 5. Miscellaneous record submittals.

1.2 RELATED REQUIREMENTS

- A. Section 01 77 00 - Closeout Procedures for general closeout procedures.
- B. Section 01 78 23 - Operation and Maintenance Data for operation and maintenance manual requirements.
- C. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Initial Submittal:
 - a. Submit PDF electronic files of Contractor's paper-copy set(s) of marked-up record prints.
 - b. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - 2. Final Submittal:
 - a. Submit PDF electronic files of scanned record prints.
 - b. Print each drawing, whether or not changes and additional information were recorded.
 - 3. Final Submittal:
 - a. Submit record digital data files.

- b. Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Model: Comply with Owner's requirements.
- C. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- D. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- E. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

PART 2 PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding 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. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets in red. 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.

2.2 RECORD DIGITAL DATA FILES

- A. 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. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor with digital data files of the original Contract Drawings for use in recording information.
 - a. Architect makes no representations as to the accuracy or completeness of Electronic Drawings as they relate to the Contract Drawings.
 - b. Digital Data Software Program: The electronic files will be made available in the digital data software program in which they were produced by the Architect. Contractor is responsible for any necessary conversions to an alternate software program.

- c. See Section 01 33 00 - Submittal Procedures and "Electronic File Transfer Agreement" form for requirements related to use of Architect's digital data files.
- B. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where 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. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- C. 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. 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.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.3 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 scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.4 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 and record Drawings where applicable.
- B. Format: Submit record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.
1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.5 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked-up miscellaneous record submittals.
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

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. 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 reference during normal working hours.

END OF SECTION

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for instructing Owner's personnel, including the following:
1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 2. Demonstration and training video recordings.
 3. Descriptions and responsibilities for commissioning demonstration and training requirements.

1.2 SUBMITTALS

A. Informational Submittals:

1. 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.
 - a. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products.
2. Attendance Record: For each training module, submit list of participants.

B. Closeout Submittals:

1. Demonstration and Training Video Recordings: Submit within seven days of end of each training module.
 - a. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 01 78 23 - Operation and Maintenance Data.

1.3 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect and Owner.

1.4 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.

- f. Identification systems.
- g. Warranties and bonds.
- h. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:

- a. Diagnosis instructions.
- b. Repair instructions.
- c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

1.5 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 - Operation and Maintenance Data.
- B. Set up instructional equipment at instruction location.

1.6 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.
 1. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner with at least 10 days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.7 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
- B. Digital Video Recordings:
 - 1. Submit video recording by method acceptable to Owner.
 - 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 on name of equipment generally described in video segment, as identified in Project specifications.

END OF SECTION

SECTION 02 41 19
SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Demolition and removal of selected portions of building or structure.

1.2 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
- B. Section 01 73 00 - Execution for cutting and patching procedures.
- C. Section 01 74 19 - Construction Waste Management and Disposal for disposal of demolished materials.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

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

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review items to be salvaged and stored for re-use, including Owner-designated storage areas.
 - 5. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

6. Review areas where existing construction is to remain and requires protection.

1.6 SUBMITTALS

A. Informational Submittals:

1. Qualification Data: For refrigerant recovery technician.
2. Engineering Survey: Submit engineering survey of condition of building.
3. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property for environmental protection, dust control, and noise control. Indicate proposed locations and construction of barriers.
4. Schedule of Selective Demolition Activities: Indicate the following:
 - a. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's, building manager's, and other tenants' on-site operations are uninterrupted.
 - b. Interruption of utility services. Indicate how long utility services will be interrupted.
 - c. Coordination for shutoff, capping, and continuation of utility services.
 - d. Use of elevator and stairs.
 - e. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
5. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 33 - Photographic Documentation. Submit before Work begins.
6. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
7. 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.
8. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

B. Closeout Submittals:

1. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

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

1.8 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. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 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. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

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

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Engage a professional engineer to 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.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs or video, and templates.
 - 1. Comply with requirements specified in Section 01 32 33 - Photographic Documentation.

2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

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

3.3 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. Arrange to shut off utilities with utility companies.
 2. Notify the Architect immediately if the removal of fire-suppression, plumbing HVAC, electrical, communications, and safety and security systems or components will adversely affect the operation of those systems outside the limits of demolition.
 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.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 - Temporary Facilities and Controls.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 - Construction Waste Management and Disposal.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. 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.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- 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.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 03 54 16
CEMENT-BASED UNDERLAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cement-based, polymer-modified, self-leveling underlayment for application below interior floor coverings.
 - 1. Broad scope leveling of existing concrete floors scheduled to have existing flooring and associated adhesive removed, and new finish flooring applied.
 - 2. Transitioning leveling of floors to create uniform level height between different flooring materials.

1.2 RELATED REQUIREMENTS

- A. Section 01 22 00 - Unit Prices for underlayment unit prices.

1.3 SUBMITTALS

A. Action Submittals:

- 1. Product Data: For each type of product indicated.
- 2. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

B. Informational Submittals:

- 1. Qualification Data: For qualified Installer.
- 2. Product Certificates: Signed by manufacturers of underlayment and floor-covering systems certifying that products are compatible.
- 3. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

- 1. Place cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

1.7 COORDINATION

- A. Coordinate application of underlayment with requirements of floor-covering products and adhesives, to ensure compatibility of products.

PART 2 PRODUCTS

2.1 CEMENT-BASED UNDERLAYMENTS

- A. Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thickness of 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.

- 1. Products:

- a. Ardex; K-15 Self-Leveling Underlayment Concrete.
 - b. BASF Construction Chemicals, Inc.; MBT Mastertop 110 Plus Underlayment.
 - c. Dayton Superior Corporation; LeveLayer.
 - d. L&M Construction Chemicals, Inc.; Levelex.
 - e. MAPEI Corporation; Ultraplan 1 Plus.

- 2. Cement Binder: ASTM C150/C150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C129.

- 3. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C109/C109M.

- B. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

- C. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
 - 1. Primer shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance.
 - 1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
 - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 - 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
- C. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.
- D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.

2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, level surface. Sloping of 1/8 inch in 10'-0" maximum is permitted to produce level surface.
1. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- E. Transitioning Leveling: Apply underlayment as required to create uniform level height between different flooring materials, where transition strips are not indicated on Drawings. Leveling shall extend out as needed to conform to ADA requirements.
- F. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Metal fabrications, including the following:

1. Loose lintels.
2. Shelf angles.
3. Steel weld plates and angles for casting into concrete not specified in other Sections.
4. Steel framing and supports for countertops.
5. Slotted channel framing
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Miscellaneous angles, shapes and fabrications shown on the Drawings.
8. Anchors, framing, fasteners and accessories for installation of the above.
9. Design calculations for those items required to have such.

B. Related Sections include the following:

1. Painting: Section 09 91 00.
2. Solid Surface Countertops: Section 12 36 62.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design:

1. Design metal fabrications, including engineering calculations prepared by a qualified Structural Engineer, using structural performance requirements and design criteria indicated herein.
2. Contractor is responsible for the engineering and design of components and materials, as well as the installation of the metal fabrications.

B. Supports for Countertops:

1. Dead load of counters.
2. Uniform Load: 50 pounds per linear foot of counter.
3. Concentrated Load Downward: 200 pounds at any point on the counter.
4. Limit deflection to L/360 between supports.

- C. Exterior Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. 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.
- D. Information on Drawings and in the Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated on the Drawings by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines and relationships to one another and to adjoining construction. Performance characteristics are indicated by criteria specified herein subject to verification as specified.
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's written approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect in accordance with Section 01 60 00 "Product Requirements" for review prior to submittal of shop drawings.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal fabrications.
1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 2. Provide templates for anchors and bolts specified for installation under other Sections.
 3. Where fabrications require calculations, provide shop drawings sealed and signed by the same State of Illinois Licensed Structural Engineer that prepared calculations.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Data: For the following:
1. Grout.
 2. Shop and zinc primer.
- B. Welding certificates.

- C. Qualification Data: For Structural Engineer.
- D. Design Calculations: Provide for fabricated items requiring design calculations to substantiate design and installation conditions, prepared, sealed, and signed by a State of Illinois Licensed Structural Engineer. Submit design calculations for the following:
 - 1. Metal pan (open grating, steel floor plate) stairs.
 - 2. Countertop support framing.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications 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.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, Structural Welding Code--Steel.
 - 2. AWS D1.2, Structural Welding Code--Aluminum.
 - 3. AWS D1.3, Structural Welding Code--Sheet Steel.
 - 4. AWS D1.6, Structural Welding Code--Stainless Steel.
- C. Comply with AISC Manual.
 - 1. Code of Standard Practice for Steel Buildings and Bridges.
 - 2. Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.
- D. Specifications for Structural Joints Using High Strength Steel as approved by the Research Council on Structural Connections.
- E. General Requirements for Delivery of Rolled Steel Plates, Shapes, and Bars for Structural Use: ASTM A 6.
- F. Bar Grating: Comply with NAAMM, Metal Bar Grating Manual.
- G. Qualifications for Welding Work:
 - 1. Qualify welding processes and welding operators in accordance with the AWS, Standard Qualification Procedure.
 - 2. Provide certification that welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous twelve months. Provide recertification of welders as required.

- H. Comply with applicable portions of National Association of Architectural Metal Manufacturers (NAAMM) Metal Stairs and Pipe Railing Manuals.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on shop drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. 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.
- B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to project site in time for installation.

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. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METALS - GENERAL

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

2.3 MATERIALS

- A. W-Shapes: ASTM A 992, Grade 50.
- B. Channels and Angles: ASTM A 36.
- C. Steel Plates, Shapes, and Bars: ASTM A 36.
- D. Steel Sheet:
 - 1. Cold-Rolled: ASTM A 1008, Type B, structural steel, Grade 25, unless another grade is required by design loads indicated.
 - 2. Hot-Rolled: ASTM A 1011, Type B, or structural steel, Grade 30, unless another grade is required by design loads.
- E. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- F. Stainless Steel Bars and Shapes: ASTM A 276, Type 304.
- G. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- H. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads, black, galvanized for exterior or as noted on the Drawings.
- I. Stainless Steel Pipe and Tubing: ASTM A 554, Type 304.
- J. Steel Bars for Grating: ASTM A 569 or ASTM A 36.
- K. Stainless Steel Shapes: ASTM A 276, Type 304 and Type 316 where indicated herein.
- L. Rolled Steel Floor Plates: ASTM A 786, rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D. Provide manufacturer's standard raised diamond pattern.
- M. Rolled Aluminum Alloy Tread Plate: ASTM B 632, alloy 6061-T6. Provide manufacturer's standard diamond pattern.

- N. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4. Continuously slotted steel channels with in-turned lips, size and series as shown on the Drawings, if not shown, as required to support and resist the imposed loads, with assembly and mounting hardware as required by conditions of the fabrication and installation.
1. Size of Channels: 1-5/8 by 1-5/8 inches unless otherwise indicated on the Drawings.
 2. Material: Cold-rolled steel, ASTM A 1008, structural steel, Grade 33, 0.0528-inch minimum thickness; galvanized after fabrication.
 3. Product: "Unistrut" (Unistrut Corporation, Wayne MI 48184) or other as approved by Architect.
 4. Medical Support Systems:
 - a. Cooper B-Line, Inc., Highland, IL.
 - b. Flex-Strut, Inc. Metal Framing Products, Warren, OH.
 - c. "Globe Strut" (GS Metals Corporation).
 - d. "Hilti Strut MQ" (Hilti, Inc.).

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. High-Strength Bolts, Nuts, and Washers: ASTM F 3125/F 3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A 563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36.
1. Provide hot-dip or mechanically deposited, zinc coated anchor bolts where item being fastened is indicated to be galvanized.
- F. Eyebolts: ASTM A 489.
- G. Machine Screws: ASME B18.6.3.

- H. Lag Bolts: ASME B18.2.1.
- I. Wood Screws: Flat head, ASME B18.6.1.
- J. Plain Washers: Round, ASME B18.22.1.
- K. Lock Washers: Helical, spring type, ASME B18.21.1.
- L. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- M. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Anchors in Interior Locations: Carbon steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material for Anchors in Exterior Locations: Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.
 - 3. Provide one of the following:
 - a. "Kwick Bolt 3" (Hilti Corporation, Tulsa, OK 74121).
 - b. "Expansion Anchors" (Dur-O-Wall, Hauppauge, NY, 11788).
 - c. "Expansion Anchors" (ITW Redhead, Addison, IL 60101).
- N. Power Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with capability to sustain, without failure, a load equal to ten times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency. Provide manufacturer's substantiating data for each type and condition used as part of submittals.
- O. 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, two 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.

2.5 MISCELLANEOUS MATERIALS

- A. Wedge Inserts (Shelf Angle Support Insert Assembly):
1. Heavy box type ferrous casting inserts, duty ductile iron complying with ASTM A 47 or cast steel complying with ASTM A 27, hot-dip galvanized in accordance with ASTM A 153, with carbon steel wedge shaped askew bolts, round washers, shimming washers and hex nuts hot-dip galvanized in accordance with ASTM A 153, insert size, bolt sizes and shear loads as shown on the Drawings, one of the following:
 - a. Dayton Superior, No. F-7-H, Miamisburg, OH 45342.
 - b. Heckmann Building Products, Inc., No's. 425 & 427, Chicago, IL 60624.
 - c. Hohmann & Barnard, Inc., Type LW or HW, Hauppauge, NY 11788.
 2. Provide wedge inserts to Cast-in-Place Concrete Contractor for insertion into concrete formwork.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- C. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer complying with MPI #79.
1. Use primer with a VOC content of 3.5 lb/gal. or less when calculated according to 40CFR59, Subpart D (EPA Method 24).
 2. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
 3. Provide one of the following:
 - a. "OEM" (Carboline Company, St. Louis, MO 63144).
 - b. "Series 10-1009" (Tnemec, Company, Inc., Kansas City, MO 64141).
 - c. "Amercoat 185H" (PPG).
- D. Zinc Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
1. Use primer with a VOC content of 3.5 lb/gal. or less when calculated according to 40CFR59, Subpart D (EPA Method 24).
 2. Products:
 - a. "Carbozinc 621" (Carboline Company).
 - b. "Amercoat 68HS" (PPG Ameron).
 - c. "Tneme-Zinc 90-97" (Tnemec Company, Inc.).
- E. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

- F. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D 1187.
- G. Nonshrink, Nonmetallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 - Cast-in-Place Concrete for normal weight, air entrained, ready mix concrete with a minimum 28-day compressive strength of 3,000 psi, unless otherwise indicated.

2.6 FABRICATION - GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Furnish inserts if units are installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition shop drawings.
- D. Galvanize miscellaneous framing and supports where indicated.
- E. Prime miscellaneous framing and supports with zinc rich primer where indicated.

2.8 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

2.9 SHELF ANGLES

- A. Fabricate structural steel shelf angles of sizes shown on the Drawings for attachment to the building frame. Fabricate with slotted holes to receive 3/4 inch diameter bolts spaced not more than 24 inches o.c. and not less than 6 inches from end of angles unless shown otherwise on the Drawings. At inside and outside corners, provide mitered or coped angles to extend the horizontal leg into the corner for support of brick and flashing.
- B. Provide galvanize shelf angles to be installed on exterior concrete framing.
- C. Provide stainless steel shelf angles where in direct contact with limestone or granite.
- D. Furnish wedge type concrete insert assemblies complete with askew head bolts for attachment of angles to cast-in-place concrete.

2.10 MISCELLANEOUS STEEL TRIM

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

2.11 FINISHES - GENERAL

- A. Comply with NAAMM's - Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.12 STEEL FINISHES

- A. Galvanizing: In addition to items and fabrications indicated herein and on the Drawings, galvanize exterior items, products and fabrications unless indicated otherwise. Hot-dip galvanize items as indicated to comply with applicable standard listed below:
1. ASTM A 123 for galvanizing steel and iron products.
 2. ASTM A 153 for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
1. Exteriors (SSPC Zone 1B) (and Items Indicated to Receive Zinc Rich Primer): SSPC-SP 6/NACE No. 3, Commercial Blast Cleaning.
 2. Interiors (SSPC Zone 1A): SSPC-SP-3, Power Tool Cleaning.
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA-1, Paint Application Specification No.1, Shop, Field, and Maintenance Painting of Steel, for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on shop drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 ADJUSTING AND CLEANING

- A. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0 mil dry film thickness.
- B. Touch-up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 00 - Painting.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 INSPECTION AND TESTS

- A. The testing laboratory will make inspections and perform tests in accordance with the following:
1. Verify that certification of welders is not more than one year prior to time welding work is to be performed.
 2. Visually inspect shop and field welds. Conform with AWS D1.1., Structural Welding Code for Steel.
 3. Test bolted connections made either in the shop or in the field in accordance with the following:
 - a. Test bolted connections by the calibrated wrench method as outlined in the Specifications for Assembly of Structural Joints Using High Strength Steel Bolts hereinbefore specified. The testing laboratory is responsible for the proper calibration of the wrench used.
 - b. Test 10 percent of installed bolts as specified, with a minimum of two bolts for each connection being tested.
- B. Correct deficiencies in metal fabrication work which inspections and tests have indicated to be in non-compliance with the requirements of the Contract Documents. Perform additional tests, at Contractor's expense as may be necessary to reconfirm any noncompliance or original work, and as may be necessary to show compliance of corrected work.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Rough carpentry and framing, including the following:

1. Wood framing, blocking, furring, nailers, and grounds for the anchor or support of other items or construction as necessary to render the work secure and complete.
2. Wood preservative treatment for lumber and plywood.
3. Wood fire retardant treatment for lumber and plywood.
4. Anchors, fasteners, and hardware.

B. Related Sections:

1. Plastic laminate casework: Section 06 41 00.
2. Flush wood doors: Section 08 14 16.
3. Gypsum board: Section 09 29 00.

1.2 ACTION SUBMITTALS

- A. Shop Drawings, Glue Laminate Members: Show laminate members, indicate configurations, dimensions, span, pitch, camber, and material species. Show connections.

1.3 INFORMATIONAL SUBMITTALS

A. Product data for the following products:

1. Underlayment.
2. Metal framing anchors.
3. Sill sealer.
4. Air infiltration barrier.

B. Certification:

1. Submit certification by treating plant stating chemicals and process used, net amount of salts retained and conformance with applicable standards.

2. Preservative Treated Wood: Submit certification for waterborne preservative that moisture content was reduced to 19 percent maximum, after treatment for lumber and 15 percent for plywood.
 3. Fire Retardant Treatment: Submit certification by treating plant that fire retardant treatment materials comply with governing ordinances and that treatment will not bleed through finished surfaces.
- C. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for project.
1. Engineered wood products.
 2. Metal framing anchors.

1.4 QUALITY ASSURANCE

A. Grading Rules:

1. Provide lumber conforming to the grading rules and wood species of the DOC Voluntary Product Standard PS-20. Grading rules of the following associations also apply to materials produced under their supervision:
 - a. Northeastern Lumber Manufacturer's Association, Inc. (NELMA).
 - b. Southern Pine Inspection Bureau (SPIB).
 - c. West Coast Lumber Inspection Bureau (WCLIB).
 - d. Western Wood Products Association (WWPA).
2. Provide plywood conforming to the following:
 - a. Softwood Plywood - Construction and Industrial: DOC Product Standard PS-1.
 - b. Hardwood Plywood: DOC Product Standard PS-51.

B. Grading Marks: Identify lumber and plywood by official grade mark.

1. Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, where applicable and condition of seasoning at time of manufacture.
 - a. S-Dry: Maximum 19 percent moisture content.
 - b. MC-5 or KD: Maximum 15 percent moisture content.
 - c. Dense.
2. Softwood Plywood: Maximum grade trademark of the APA The Engineered Wood Association.
 - a. Type, grade, class and identification index.
 - b. Inspection, testing or grading agency.

3. Hardwood Plywood: Appropriate grade mark of qualified inspection, testing or grading agency.
- C. Testing: ASTM E 84, maximum 25 flame spread rating.
- D. Requirements of Regulatory Agencies:
1. Fire Hazard Classification: Underwriters' Laboratories, Inc., for treated lumber and plywood.
 2. Pressure Preservative Treated Lumber and Plywood: American Wood Preservers' Association Standards.
 3. Span Tables: American Forest & Paper Association (AFPA) American Wood Council (AWC).
 4. Working Stresses: Softwood Lumber, National Design Specification, American Forest & Paper Association (AFPA) American Wood Council (AWC).
- E. Glue Laminated Structural Units:
1. Provide glue laminated members bearing the American Institute of Timber Construction (AITC) Quality Control Mark.
 2. Glue laminate supplier is to be a firm licensed by the American Institute of Timber Construction to use AITC Quality Inspection Marks and to ensure the AITC Certificate of Conformance.
 3. Comply with AITC 111, Recommended Practice for Protection of Structural Glue-Laminate Timber During Transit, Store and Erection.
- F. Framing Standard: Comply with AFPA, Manual for Wood Frame Construction, unless otherwise indicated herein or required by governing codes.
- G. Nailing:
1. Recommended Nailing Schedule of referenced framing standard and with AFPA, National Design Specifications for Wood Construction.
 2. Roof Sheathing Fastening Schedules for Wind Uplift, APA The Engineered Wood Association.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Immediately upon delivery to job site, place materials in area protected from weather.
- B. Store materials a minimum of 6 inches above ground on framework or blocking and cover with protective waterproof covering, providing adequate air circulation or ventilation.
- C. Do not store seasoned materials in wet or damp areas.

- D. Protect fire retardant materials against high humidity and moisture during storage and erection.
- E. Protect sheet materials from corners breaking and damaging surfaces, while unloading.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber:

- 1. Dimension:
 - a. Specified lumber dimensions are nominal.
 - b. Actual dimensions conform to industry standards established by the American Lumber Standards Committee and the rules writing agencies.
- 2. Moisture Content: 19 percent maximum at time of permanent closing in of building or structure for lumber 2 inches or less nominal thickness.
- 3. Surfacing: Surface four sides (S4S), unless otherwise shown on the Drawings or specified.
- 4. Framing lumber, 2 inch to 4 inch thick, 2 inch to 4 inch wide, any commercial softwood species, unless otherwise shown on the Drawings or specified.
 - a. Light Framing:
 - 1) General Framing: DF-L, Stud Grade and Better Grade.
 - 2) Plates, Blocking, Bracing and Nailers: DF-L, No.2 or Better Grade.
 - b. Studs:
 - 1) Load-bearing: DF-L, Select Structural, No. 2 or Better Grade.
 - 2) Non-load-bearing: DF-L, Stud Grade, Standard Grade.
 - c. Structural Light Framing (beams and posts), 2 inch to 4 inch thick, 2 inch and wider: DF-L, Select Structural, No.2 or Better Grade.
 - d. Joists: DF-L, Select Structural, No.2 or Better Grade.
 - e. Appearance Framing, 2 inch to 4 inch thick, 2 inches and wider: Appearance Grade, 15 percent maximum moisture content, MC-15 or KD on grade stamp.
- 5. Boards: 1 inch to 2 inch thick; any commercial softwood species, unless otherwise shown on the Drawings or specified:
 - a. Furring and Grounds: Minimum, No. 2 Common Grade.

B. Plywood:

- 1. Roof and Wall Sheathing: APA Rated Sheathing, Exterior (Exposure 1), thickness as shown on the Drawings or if not shown provide 3/4 inch thick panels.

2. Roof and Wall Sheathing (Structural): APA Structural 1 Rated Sheathing, Exposure 1, thickness as shown on the Drawings or if not shown provide 3/4 inch thick panels.
 3. Subfloor: APA Rated Sheathing, Exposure 1, tongue-and-groove, thickness as shown on the Drawings or if not shown provide 3/4 inch thick panels.
 4. Combination Subfloor Underlayment: APA Rated Stud-I-Floor, Exposure 1, tongue-and-groove, 3/4 inch thick unless noted otherwise on the Drawings.
 5. Underlayment: APA C-C Plugged, Exposure Durability, Exterior, in areas where moisture is present, fire retardant treated, tongue-and-groove, 3/4 inch thick unless noted otherwise on the Drawings.
 6. Marine Plywood: APA B-B Marine Grade, 3/4 inch thick unless noted otherwise on the Drawings.
- C. Preservative Treatment by Pressure Process: AWPA U1, pressure treated preservatives for painted, stained or exposed natural wood products. Provide kiln dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood:
1. Category UC2 for interior construction not in contact with ground.
 2. Category UC3b for exterior construction not in contact with ground.
 3. Category UC4a for items in contact with ground.
- D. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Treatment shall not promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
- E. Sill Seal: Compressible foam plastic seal, same width as sill plate roll form, Amfoam Sill Sealer, as manufactured by Amco Foam Products Company, Smyrna, GA 30080 or other as approved by Architect.

- F. Air Infiltration Barrier: Spunbound polyethylene fiber sheeting, complying with ASTM E 1677, Type I, Tyvek Housewrap as manufactured by DuPont Company, Wilmington DE 19880 or other approved by Architect.

2.2 METAL FRAMING ANCHORS AND HARDWARE

- A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows:
1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for project.
 2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Galvanized Steel Sheet: Hot-dip, zinc coated steel sheet complying with ASTM A 653, G60 coating designation; structural, commercial, or lock forming quality, as standard with manufacturer for type of anchor indicated.
- C. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches wide by 9/16 inch deep by 0.034 inch thick with hemmed edges.
- D. Rough Hardware: Zinc coated steel, unless otherwise shown on the Drawings or specified:
1. Bolts: FS FF-B-575C.
 2. Nuts: FS FF-N-836C.
 3. Expansion Shields: FS FF-B-561C.
 4. Lag Screws and Bolts: FS FF-B-561C.
 5. Toggles Bolts: FS FF-B-588C.
 6. Wood Screws: FS FF-S-111D.
 7. Nails and Staples: FS FF-N-105B.
 8. Joist Hangers: Minimum 18 gage.
 9. Metal Cross Bridging: 16 gage.
 10. Bar and Strap Anchors: ASTM A 525, minimum 18 gage, hot-dip galvanized.
 11. Plyclips: Extruded aluminum alloy, ASTM B 221, 6063-T6.
- E. Acceptable Metal Framing Anchor Manufacturers:
1. Heckman Building Products, Chicago, IL 60624.

2. KC Metal Products, Inc., San Jose, CA 95131.
3. Simpson Strong-Tie Company, Inc., Pleasanton, CA 94588.
4. Southeastern Metal Manufacturing Company, Jacksonville, FL 32218.

PART 3 EXECUTION

3.1 PREPARATION

- A. Examine surfaces to receive the parts of the work specified herein. Verify dimensions of in-place and subsequent construction. Application or installation of materials constitutes acceptance of existing conditions.

3.2 INSTALLATION

- A. General: Frame wood members to a close fit, set accurately to required lines and levels and secure rigidly in place in accordance with the Drawings. Cut to fit framing, blocking, etc. to accommodate other work.
- B. Nailing: Provide as a minimum nailed connections for wood framing members in accordance with the National Design Specifications for Wood Construction, American Forest & Paper Association but not less than specified below, unless otherwise noted on the Drawings. Provide nails shown and noted as common unless otherwise noted. Clinch ends of nails which project from wood members when direct nailing is indicated.
 1. Studs and Plates:
 - a. Stud to Sole Plate: Toe-Nail, 4-8d or 2-16d (Direct).
 - b. Stud to Cap Plate: Toe-Nail, 2-14d.
 - c. Double Studs: Direct, 10d: 12 inches o.c. or 16d 24 inches o.c.
 - d. Corner Studs: Direct, 16d: 24 inches o.c.
 - e. Sole Plate to Joist or Blocking: Direct, 16d: 16 inches o.c.
 - f. Double Cap Plate: Direct, 16d: 16 inches o.c.
 - g. Cap Plate Laps: Direct, 2-16d.
 2. Headers and Girders:
 - a. Built-Up Girders and Beams: Direct, 20d at 32 inches o.c. top and bottom edge staggered 2-20d at ends.
 - b. Continuous Header - Two Pieces: Direct, 16d at 16 inches o.c. each edge.
- C. Sills:

1. Set preservative wood treated sills on specified continuous foam sill sealer flush exterior face of foundation unless shown otherwise on the Drawings. Impale foam sealer over anchor bolts and butt end joints together (not lapped).
 2. Secure sills with 5/8 inch diameter x 10 inch long with 2 inch hook minimum size anchor bolts embedded in the structure minimum 8 inches, spaced maximum 4 feet o.c.
 3. Join solid sill members with halved joints, where not continuous and at corners, minimum 1 foot lapped joint.
 4. Lap built-up sill members minimum distance 2 feet.
- D. Bridging: Install bridging not to exceed 6 feet o.c.
1. Metal Cross Bridging: Install nailable type with two 8d nails in each end, leaving a space between members minimum of 1/8 inch.
 2. Wood Cross Bridging:
 - a. Install 1 inch x 4 inch wood strips with beveled ends in double cross manner.
 - b. Secure cross bridging with two 8d nails in each end.
 - c. Nail bottom end of cross bridge strips after subfloor is installed.
 3. Solid Bridging: (Where shown on Drawings)
 - a. Size: 2 inch thickness x 2 inch less in height than joists, length to suit.
 - b. Install offset to permit toenailing or endnailing.
 - c. Space Bridging Maximum:
 - 1) Spans to 10 feet: one row midspan.
 - 2) Spans 10 feet to 18 feet: two rows at 1/3 span.
 - 3) Spans over 18 feet: rows not over 6 feet apart.
- E. Plywood Wall Sheathing:
1. Install with face grain horizontal.
 2. Allow minimum 1/16 inch space at end joints and 1/8 inch at edge joints; double these spacings under wet or humid conditions.
 3. Nail 6 inches o.c. along panel edges and 12 inches o.c. at intermediate supports with 6d common nails for panels 1/2 inch thickness and less and 8d nails for greater thicknesses.
- F. Subfloor and Underlayment:
1. Install subfloor with face grain perpendicular to joists, end joint supported on joists. Install underlayment perpendicular to subfloor.
 2. Install lumber blocking between joists when tongue-and-groove panels are not used.
 3. Stagger end joints.
 4. Butt ends and edges, allowing 1/16 inch space between panels.

5. Nail plywood 3/4 inch thick or less maximum of 6 inches o.c. at panel edges and 10 inches o.c. at intermediate supports with 6d ring shank or screw type nails with 1 inch penetration into structural members, except when supports are spaced 48 inches o.c., space nails maximum of 6 inch o.c. at supports with 1 inch penetration.
6. Nail plywood 7/8 inch thick and greater with 8d common nails spaced maximum of 6 inches o.c. at panel edges and 10 inches at intermediate supports.
7. Set nail heads into plywood 1/32 inch without dimpling surface or breaking surface fiber.

G. Air Infiltration Barrier:

1. Install over sheathing a continuous air infiltration barrier attached to the sheathing with non-corrosive staples of the type recommended by the air barrier manufacturer.
2. Lap seams minimum 2 inches and seal at top and bottom edges of wall with duct tape or a similar sheathing tape as recommended by the air barrier manufacturer.
3. Cut in windows, doors and other penetrations and pull air barrier into opening and staple or attach ends to the inside of the opening.

H. Fire Retardant Treated Wood Products:

1. Provide fire retardant treated wood for framing, blocking, furring, nailing strips, and plywood where shown on the Drawings and required by local codes.
2. Apply two brush coats of same treatment used in original treatment to sawn or cut surfaces of fire treated lumber and plywood.

I. Pressure Treated Wood Products:

1. Provide pressure treated wood for framing, blocking, furring and nailing strips built into exterior and masonry walls, wood in contact with masonry or concrete and in conjunction with flashing, coping and roofing membranes.
2. Apply two brush coats of same preservative used in original treatment to sawn or cut surfaces of treated lumber.

END OF SECTION

SECTION 06 41 00

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Custom fabricated plastic-laminate-clad casework, including the following:
 - 1. Casework Fabrications:
 - a. Freestanding casework.
 - b. Countertops.
 - c. Base and wall cabinets.
 - d. Built-in casework.
 - 2. Hardware and accessories for complete fabrication and installation.
 - 3. Wood furring, blocking, shims, and hanging strips for installing architectural casework that are not concealed within other construction.
 - 4. Site installation.
- B. Related Sections:
 - 1. Rough carpentry: Section 06 10 00.
 - 2. Glazing: Section 08 80 00.
 - 3. Stainless Steel countertops: Section 12 36 17.
 - 4. Plastic-laminate countertops: Section 12 36 23.

1.2 COORDINATION

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

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Literature:

1. Manufactured materials description, manufacturer's catalog cut sheets of casework/cabinet hardware indicating model numbers and finishes of each item used in fabrication.
 2. Manufacturer's literature for fire retardant treated materials.
- B. Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale details, hardware, finishes, anchors and other components. Indicate compliance with specified standards and other specified requirements for materials and workmanship.
- C. Samples: Samples will be reviewed for appearance and finish only. Compliance with other requirements is the exclusive responsibility of the Contractor.
1. Submit sample chains of plastic laminate and cabinet liner for color and pattern selection by Architect.
 2. Cabinet/Casework Hardware: Each item specified used in the fabrications, in finish indicated herein.

1.5 INFORMATIONAL SUBMITTALS

A. Certification:

1. Copies of certificate signed by the Fabricator/Installer, certifying that the work complies with the quality standards, grades and other requirements as referenced and specified herein.
2. Signed by manufacturers certifying that products furnished comply with fire resistive requirements.
3. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

A. Fabricator/Installer:

1. Provide custom casework, finishing and installation executed only by a custom casework fabricator/installer skilled and experienced in highest quality custom casework and which can furnish satisfactory evidence to the Architect as to recent installations of similar type and quality.
2. The custom casework fabricator/installer is to have a minimum of 5 consecutive years experience in the type and quality of casework shown on the Drawings and specified herein.
3. Shop is a certified participant in AWI's Quality Certification Program.
4. Installer is a certified participant in AWI's Quality Certification Program.

- B. Reference Standards: Comply with the applicable provisions for grading and workmanship of the Architectural Woodwork Institute (AWI), latest standards, herein referred to as Standards, except as otherwise specified.
- C. Fire Test Response Characteristics: Where fire retardant materials or products are indicated or required by authorities having jurisdiction, provide materials and products with specified fire test response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Protect casework during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver casework until painting, wet work, grinding and similar operations which could damage, soil or deteriorate casework has been completed and the HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period in installation areas.
- C. If, due to unforeseen circumstances, casework must be stored in other than installation areas, store only in area which meet the requirements specified for installation areas.

1.8 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: Do not install casework until the required temperature and relative humidity have been stabilized in installation areas. Condition casework to average prevailing humidity and temperature conditions in installation areas prior to installing.
- B. Coordination:
 - 1. Coordinate design, fabrication and assembly of casework fabrications with other materials, elements, equipment and fabrications that are attached to, installed in, or are part of the completed installation.

2. Verify dimensions and field conditions and review shop drawings of other trades, equipment and fabrications which attached to, in, or a part of the complete installation to assure proper fit, finish and function of the completed installation.
- C. Field Measurements: Where casework is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing casework; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.
1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with manufacture of casework without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Plastic Laminate: Comply with requirements of Publication No. LD 3 by the National Electrical Manufacturers Association (NEMA) for General Purpose Type (HGS and VGS), nominal 0.048 inch thick and Postforming Type (HGP and VGP), nominal 0.038 inch thick, solid color laminates, Grade CC (Matte), nominal 0.034 inch thick. Colors, patterns and texture selected by the Architect with a maximum of 3 colors being utilized in the plastic laminate fabrications from samples of the following manufacturers:
1. Formica Corporation, Cincinnati, OH 45241.
 2. Lamin-Art, Schaumburg, IL 60173.
 3. Nevamar, Panolam Industries, Shelton, CT 06484
 4. Pionite Decorative Surfaces, Auburn, ME 04210.
 5. Wilsonart LLC, Temple, Texas 76503.
 6. Abet Inc., Englewood, NJ 07631.
- B. Cabinet Liner: Plastic laminate manufacturer's standard products complying with CLS/-72.
- C. Thermoset Decorative Overlay Cabinet Liner: Surface of thermally fused, melamine impregnated decorative paper complying with LMA SAT-1 over specified medium density particleboard.
- D. Backing Sheet: Plastic laminate manufacturer's standard products complying with BKS/-91.

E. Adhesives:

1. Do not use adhesives that contain urea formaldehyde
2. Fire Retardant Treated Materials: Resorcinol.

F. Casework/Cabinet Construction Materials: Provide materials that comply with requirements of the Standards for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:

1. Hardboard: ANSI/AHA A135.4.
2. Medium Density Particleboard: ANSI A208.1.
3. Medium Density Fiberboard: ANSI A208.2, Grade MD.
4. Medium Density Fiberboard: Industrial Grade Medium Density Fiberboard (MDF), manufactured with a formaldehyde-free adhesive system which meets the requirements of ANSI A208.2, Grade 150, as manufactured by one of the following:
 - a. Flakeboard Company Limited
 - b. McKillican International, Inc.
 - c. Sierrapine Ltd.
5. Softwood Plywood: PS 1
6. Medium Density Overlay: 3/4 inch thick plywood, APA Grade MDO.
7. Internal Wood Framing and Blocking: Appearance Grade, 15 percent maximum moisture content, MC-15 or KD on grade stamp.

G. Wall mounted shelf supports: Surface mounted Heavy-Duty pilaster type slotted steel standards and brackets as shown in drawings, minimum 16-ga BHMA Grade 2 Compliant. "KV 183 Series" (Knappe & Vogt) or similar.

H. Cabinet Hardware:

1. Open Adjustable Shelf Supports:
 - a. Adjustable Shelf Supports: Heavy duty slotted steel, BHMA B84102.
 - 1) Garcy No. 649.
 - 2) Knappe & Vogt No. 87.
 - 3) Capitol Hardware A-Line.
 - b. Caps: Provide manufacturer's standard caps at top and bottom of surface mounted standards which do not abut other surfaces.
2. Flush Mounted Adjustable Pilaster Shelf Supports: Flush mounted pilaster type slotted steel standards, comply with BHMA B84072.
 - a. Garcy Nos. S373 and A73.
 - b. Knappe & Vogt Nos. 255 and 239.
 - c. Capitol Hardware A-Line.

3. Shelf Brackets: Provide heavy duty double and triple hooked steel brackets, BHMA B84112. Provide shelf rests.
 - a. Garcy Nos. 796 and M796.
 - b. Knappe & Vogt No. 186 and 187.
 - c. Capitol Hardware A-Line.
4. Shelf End Support Clips: Steel supports with rubber cushions.
 - a. Garcy No. FE286 & FE28
 - b. Capitol Hardware A-Line No. 77 & No. 109.
 - c. Knappe & Vogt No. 256R ZN.
5. Side Pair Drawer Slides: BHMA B85062, 75 lb. rated (per pair) ball-bearing nylon rollers, 1/2 inch wide units, commercial grade, full extension.
 - a. Grant No. 346.
 - b. Knappe & Vogt No. 1330.
 - c. Accuride C3832 Series.
6. Concealed Hinges: Recessed cup and pivot type, 110 degree swing, self-closing, built-in horizontal and vertical adjustment.
 - a. Blum No. BH73B3590.
 - b. Grass Tiomos No. 160.
 - c. Hafele No. 345-47-665, Plate No. 349-32-646.
7. Pulls: Solid brass, rod type, 5/16 inch diameter, 7/8 inch finger clearance, 4 inch screw centers, finish BHMA 626 satin chrome.
 - a. Colonial Bronze No. 753.
 - b. EPCO No. MC-4024.
 - c. Stanley No. 4483.
8. Recessed Pulls: Mockett DP156-SSS.
9. Magnetic Cabinet Catches: BHMA, B43142, B43152 or B43162 (type as applicable) aluminum case, commercial grade.
10. Heavy Duty Magnetic Catches: BHMA B43172, aluminum case, commercial grade, 11.0 lbs. minimum test pull (door 16 inch wide and wider).
11. Drawer and Cupboard Locks: Mortise type, 5-pin tumbler and dead bolt, round cylinder only exposed, brass with plated finish to match BHMA 626. Provide on each unit.
12. Countertop Wire Control Grommets: Plastic grommet with spring loaded cover, color selection by Architect to match counter plastic laminate, one of the following:
 - a. Doug Mockett & Co., Flip-Top, Manhattan Beach, CA 90266.
 - b. Hafele America, CO., No. 429.99.324 (black), Archdale, NC 27263.
 - c. Hardware Concepts, Inc., No. PL6200, Opa Locka, FL 33054.

13. Finish for Exposed Cabinet Hardware: Except as otherwise indicated, provide the following finish for exposed hardware: BHMA 626 satin chrome. For items not available in required finish, provide finish selected by Architect from those available. If more than one finish is indicated, match finish of hardware items on each set of casework as indicated.

2.2 FIRE RETARDANT TREATED MATERIALS

- A. General: Where indicated, use materials impregnated with fire retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire test response characteristics specified.
 1. Use treated material that complies with requirements of Standards. 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 in solution to distinguish treated material from untreated material.
 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 by Non-Pressure Process: Apply nontoxic, water soluble, fire retardant treatment by dip, spray, roller, curtain coating, vacuum chamber, or soaking to achieve flame spread rating of 25 or less and smoke developed rating of 450 or less per ASTM E 84.
- C. Fire Retardant Treated Lumber and Plywood by Nonpressure Process: Apply nontoxic, water soluble, fire retardant treatment by dip, spray, roller, curtain coating, vacuum chamber, or soaking to achieve flame spread rating of 25 or less and smoke developed rating of 450 or less per ASTM E 84 and that contains no added urea formaldehyde.
- D. Fire Retardant Particleboard (For use with hardwood veneer): Panels complying with the following requirements, made from softwood particles, synthetic resins and fire retardant chemicals mixed together at time of panel manufacture to achieve flame spread rating of 25 or less and smoke developed rating of 200 or less per ASTM E 84 and that contains no added urea formaldehyde.
 1. For panels 3/4 inch thick and less, comply with ANSI A208.1-2009, Grade M-3 except for the following minimum properties: density, 45 lb/cu. ft; modulus of rupture, 1,600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw holding capacity on face and edge, 250 lbf and 225 lbf, respectively.

2. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Duraflake FR" (Flakeboard Company Limited).
 - b. "Pyroblock Plus" (McKillican International, Inc.).
 - c. "Encore FR" (Sierrapine Ltd.).

- E. Fire Retardant Fiberboard (Do not use with hardwood veneer): Medium density fiberboard 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 rating of 25 or less and smoke developed rating of 200 or less per ASTM E 84 and that contains no added urea formaldehyde.
 1. Product: Subject to compliance with requirements, provide one of the following:
 - a. "Vesta FR" (Flakeboard Company Limited).
 - b. "Purekor" (McKillican International, Inc.).
 - c. "Meditate FR" (Sierrapine Ltd.).

2.3 FABRICATION OF CASEWORK

- A. Examine conditions and verify dimensions at the project site. Fabrication and/or installation of the casework and related elements constitutes acceptance of the existing conditions.

- B. Not all details of casework are shown on the Drawings. The fabricator is to utilize the most advantageous manufacturing process to achieve the quality of casework indicated herein by the referenced Standards and the details shown on the Drawings.

- C. Plastic-Laminate-Clad Casework:
 1. Grade: AWI Premium Grade, Section 10, Type A construction, except as follows.
 2. Face Construction: Flush overlay type, except as otherwise indicated on the Drawings or specified herein (drawer front, doors and fixed panels conceal casework behind).
 3. Thickness and Style: As shown, or if not shown, provide minimum 3/4 inch thick medium density particleboard: counters, doors, drawer fronts and fixed panels, except where required to be thicker by standards or as shown on the Drawings; provide flush design units.
 4. Edges of Door, Drawers and Face Frame: Plastic laminate matching exposed surfaces. Ease exposed edges of overlap sheet.
 5. Backs of Doors: Plastic laminate matching exposed surfaces.

6. Backs of Plastic Laminate Components (Except Doors): Provide full backer sheets.

D. Counters:

1. Counter Construction: 3/4 inch thick, phenolic resin sealed medium density particleboard compatible with laminate adhesives, with full backer sheets, as shown on Drawings, or if details not shown, comply with standards and provide 4 inch high backsplash and endsplash, top mounted square butt joints, fully covered with matching plastic laminate, eased edges.
 2. Exposed Counter Edges:
 - a. Plastic laminate matching surface, except as otherwise indicated. Ease exposed edges of overlap sheet.
 - b. Hardwood or veneer matching veneer surface, except as otherwise indicated. Ease exposed edges of overlap veneer.
 - c. When show on the Drawings, fabricate counters and counter edges using postforming plastic laminate to form rounded counter edges.
 3. Counter Splashes:
 - a. Fabricate counters with backsplashes and sidesplashes. Fabricate to thicknesses and heights shown on the Drawings. If not shown provide minimum 4 inch high x 3/4 inch thick backsplashes and sidesplashes with exposed surface covered with plastic laminate.
 - b. When show on the Drawings, fabricate counters and splashes using postforming plastic laminate to form integral counter splash cove.
 4. Openings:
 - a. Cut openings for equipment to be installed. Comply with equipment manufacturer's requirements, but provide internal corners of 1/8 inch minimum radius. Smooth saw cut and ease edges.
 - b. Seal cut edges of counter at openings for sinks and other wet equipment, using waterproofing compound recommended by plastic manufacturer and compatible with laminating adhesive.
- E. Shop fabricate casework to the greatest extent possible, disassemble only as necessary for delivery and installation.
- F. Install hardware at the shop prior to delivery. Remove hardware for finish application and reinstall after finishing.
- G. Fabricate with scribes to fit to abutting construction.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify measurements at the project site and provide any necessary closures and trim to fit the items to enclosing walls and construction. Provide other trades with information necessary for proper completion of related work. Installation of casework and related construction constitutes acceptance of the existing conditions.
- B. Condition casework to average prevailing humidity conditions in installation areas prior to installing.

3.2 INSTALLATION

- A. Install architectural wood casework in compliance with Standards.
- B. Install plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
- C. Where architectural wood casework abuts other finished work, scribe and cut for accurate fit. Before making cutouts, drill pilot holes at corners.
- D. Attach architectural wood casework securely in place with uniform joints providing for thermal and building movements. Secure to anchors or blocking built in or directly attached to substrates.
- E. Provide tops fabricated in largest sizes practical. Assemble in field with splines for alignment and drawn tight to hairline contact with tight joint fasteners.

3.3 ADJUSTING AND CLEANING

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

3.4 PROTECTION

- A. Protection: protect installed architectural wood casework, and finishes from damage. Maintain temperature/humidity conditions during the remainder of the construction period in areas of architectural wood casework installation.

END OF SECTION

SECTION 06 61 16
SOLID SURFACE FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Solid surface fabrications, including but not limited to the following:
 - 1. Custom fabrications.
 - 2. Matching trim.
 - 3. Fittings, hardware, anchors, and accessories to complete fabrication, assembly and installation.
- B. Related Sections:
 - 1. Metal fabrications: Section 05 50 00.
 - 2. Rough carpentry: Section 06 10 00.
 - 3. Tiling: Section 09 30 00.
 - 4. Toilet accessories: Section 10 28 00.
 - 5. Applicable Division 22 plumbing sections.

1.2 ACTION SUBMITTALS

- A. Product Data: manufacturer's fabrication, installation, and finishing instructions.
- B. Shop Drawings:
 - 1. Shop drawings for fabrication and installation of each item or assembly. Include location drawings for each item or assembly, dimensioned elevations and plans and large scale details.
 - 2. Show finish and edge treatments, hardware, anchors (size and spacing), support attachment and framing locations, and accessories. Indicate adjacent and supporting construction for each item and fabrication.
- C. Samples:
 - 1. Manufacturer's standard cast sheet acrylic samples not less than 6 inches x 6 inches for the total color range available including available finishes.
 - 2. Small amount of manufacturer's color matched sealant, for each color of sheet acrylic selected by the Architect.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's maintenance instructions.

1.4 QUALITY ASSURANCE

- A. Fabricator's Qualifications: Provide cast sheet acrylic fabricated by a firm which has successfully fabricated items of similar quality and quantity of the product specified and as shown on the Drawings for a period of not less than 5 consecutive years. Fabricator to provide written evidence of such experience to the Architect upon request.
- B. Coordinate information necessary for proper installation and completion of the solid surface fabrication installations and related work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect fabrications during transit, delivery, storage and handling to prevent damage, chipping, soiling and staining.
- B. Do not deliver fabrications until adjacent and supporting construction, ceramic tile installing, painting and wet work, grinding, sanding and similar operations has been completed in the installation areas.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Solid Surface Sheet Acrylic: Cast, filled, acrylic; not coated panels, meeting ANSI Z124, Type Six and FS WW-P-541/GEN, 3/4 inch thick for counter and 1/2 inch thick for trim. Color selection by the Architect from manufacturer's standard colors with a maximum of 2 colors being utilized for fabrications. Provide one of the following:
 - 1. Products as indicated on the Drawings.
- B. Fusing and Laminating Material: Sheet acrylic panel manufacturer's standard fusing and laminating material.
- C. Sealant: Sheet acrylic panel manufacturer's standard silicone sealant color matched to counter material.

2.2 FABRICATION

- A. Examine conditions on the each fabrication and installation and verify dimensions at the project site prior to submittal of shop drawings. Fabrication of items constitutes acceptance of existing conditions.
- B. Not all details of the fabrications are shown on the Drawings, the fabricator is to utilize the most advantageous manufacturing and fabrication process in accordance with the manufacturer's printed fabrication instructions to achieve the highest quality of work. Fabricate specified items in accordance with the final reviewed shop drawings.
- C. Coordinate and receive templates for inserts, accessory cutouts, and mounting brackets, if any.
- D. Shop fabricate and finish solid surface fabrications using laminating to achieve thicknesses and edge detail shown or noted on the Drawings. Form and finish so that sheet joints are not visible. Finish edges to match face surfaces finish. Ease or chamfer exposed edges of fabrications as shown on the Drawings, if not shown provide 1/8 inch chamfers on edges.
- E. Provide protective wrapping for each fabricated item which will remain in place until completion of installation.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify dimensions and conditions of the supporting construction at the project site prior to installing each fabricated item.
- B. Installation of the fabricated items constitutes acceptance of the existing conditions.

3.2 INSTALLATION

- A. Install fabrications and accessories plumb, level, true and straight with no distortions. Install fabrications in accordance with the final reviewed shop drawings.
 - 1. Shim as required using concealed plastic shims.
 - 2. Scribe fabrications, counters, aprons and splashes to adjacent finishes and construction.

- B. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in the finished work.
- C. Anchor fabrications to the supporting construction or framework in accordance with the final reviewed shop drawings using screws, bolts and anchors of the type, size and spacing as determined by the fabricator for the conditions present.
- D. Adhere and seal joints of solid surface fabrications using manufacturer's recommended adhesives and sealants. Match color of sealant to that of countertop.
- E. Adhere solid surface fabrications to substrates using manufacturer's color matched silicone sealant. Seal top and side edges of solid surface fabrications where they abut other finish construction and tool sealant to neat consistent appearance.
- F. Touch-up finish surfaces of minor scratches, dirt, stains and damage by sanding and finishing in accordance with the manufacturer's printed instructions. Finish and blend damaged areas with adjoining surfaces. Remove and replace any fabrication that cannot be successfully repaired or refinished.

3.3 PROTECTION AND CLEANING

- A. Protect materials and finishes from damage by other work until final acceptance of the work by the Owner. Maintain shop installed protective coverings until just prior to final acceptance and cleaning.
- B. Remove protective coverings and adhesive and clean fabrications using cleaning materials and methods recommended by the sheet acrylic panel manufacturer.
- C. Repair and refinish or remove and replace defective work that cannot be repaired upon completion of the installation.

END OF SECTION

SECTION 07 21 00
BUILDING THERMAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Building thermal insulation, including the following:
 - 1. Rigid foundation insulation.
 - 2. Semi-rigid exterior wall insulation.
 - 3. Faced and unfaced blanket insulation.
 - 4. Vapor barrier for installation under concrete slabs.
 - 5. Accessories and incidental materials required for installation of the above.
- B. Related Sections:
 - 1. Joint sealants: Section 07 92 00.
 - 2. Glazing: Section 08 80 00.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples:
 - 1. 6 inch x 6 inch pieces of each type insulation.
 - 2. Typical fastener, if used.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal of vapor barrier per ASTM E1643.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

- B. Fire Test Response Characteristics: Provide insulation and related materials with the fire test response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface Burning Characteristics: ASTM E 84.
 - 2. Fire Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.
- C. Formaldehyde Free: Provide formaldehyde free products.
- D. Recycled Content: Provide glass and rock wool fiber insulation with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 10 percent.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

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. Products: Subject to compliance with requirements, provide one of the products specified.
- B. Acceptable Manufacturers:
 - 1. Diversifoam Products, Rockford, MN 55373.
 - 2. The Dow Chemical Co., Midland MI 48674.
 - 3. Owens-Corning, Parsippany, NJ 07054.
 - 4. Johns Manville, Denver, CO 80217.
 - 5. CertainTeed (A subsidiary of Saint-Gobain), Malvern, PA 19355.
 - 6. Rock Wool Manufacturing, Leeds, AL 35094.
 - 7. Rockwool International A/S, Milton, Ontario, Canada L9T 6W3.
 - 8. Thermafiber, Inc. (an Owens Corning company), Wabash, IN 46992.

9. Knauf Insulation, Shelbyville, IN 46176.

2.2 RIGID BOARD INSULATION

- A. Foundation Insulation Board: Extruded polystyrene foam board, square edge, conforming with ASTM C 578, Type IV; minimum R-Value of 10.0 at 40 deg F mean temperature for 2 inch thickness, compressive strength 25 psi minimum design value, thickness as shown on the Drawings (if not shown provide 2 inch thick boards), one of the following:
 1. "CertiFoam 25" (Diversifoam Products).
 2. "Styrofoam" (The Dow Chemical Co.).
 3. "Foamular" (Owens-Corning).
- B. Foundation Insulation Board Adhesive: Type recommended by insulation board manufacturer for the types of substrate indicated on the Drawings.

2.3 SEMI-RIGID BOARD INSULATION

- A. Cavity Insulation (Rain Screen Installations): Mineral fiber boards of rock or slag, R=4.2 per inch thickness, conforming with ASTM C 612, Type IVB, thickness as shown on the Drawings. Provide one of the following:
 1. "Roxul, CavityRock DD"
 2. "RainBarrier" (Thermafiber)

2.4 BATT (BLANKET) INSULATION

- A. Mineral Wool Fiber:
 1. Exterior Wall and Soffit Insulation: Blankets of rock or slag faced on one side with foil reinforced vapor retarder conforming with ASTM C 665, Type III, thickness as shown on Drawings.
 - a. "Roxul, AFB batts" (Rockwool).
 - b. "UltraBatt" (Thermafiber).
 2. Miscellaneous Exterior Building Voids: Blankets of rock or slag unfaced conforming with ASTM C 665 Type I, thickness as shown on Drawings.
 - a. "UltraBatt" (Thermafiber).
 - b. "Roxul, AFB batts" (Rockwool).
 - c. "Min Wool" (Industrial Insulation Group, Johns Manville).

2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
1. Products:
 - a. "Series T TACTOO Insul-Hangers" (AGM Industries, Inc.).
 - b. "Stic-Klip Type N fasteners" (Eckel Industries of Canada).
 - c. "Spindle Type" (Gemco).
 2. Plate: Perforated galvanized carbon steel sheet, 0.030 inch thick by 2 inches square.
 3. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
- B. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
1. Products:
 - a. "RC150" (AGM Industries, Inc.).
 - b. "SC150" (AGM Industries, Inc.).
 - c. "Dome-Cap" (Gemco).
 - d. "R-150" (Gemco).
 - e. "S-150" (Gemco).
- C. Insulation Standoff: Spacer fabricated from galvanized mild steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch between face of insulation and substrate to which anchor is attached.
1. Product: "Clutch Clip" (Gemco).
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
1. Products:
 - a. "TACTOO Adhesive" (AGM Industries, Inc.).
 - b. "Stic-Klip Type S Adhesive" (Eckel Industries of Canada).
 - c. "Tuff Bond Hanger Adhesive" (Gemco).

2.6 VAPOR BARRIER

- A. Vapor barrier properties:
 - 1. Permeance: less than 0.01 Perms per ASTM E 1745.
 - 2. Strength: ASTM E 1745 Class A.
 - 3. Thickness: 15 mils minimum
- B. Basis of Design: "Stego Wrap Vapor Barrier, 15-mil" (Stego Industries LLC.).
 - 1. Products:
 - a. "Griffolyn 65" (Reef Industries).
 - b. "Moistop Ultra15" (Fortifiber Building Systems Group).
- C. Accessories as recommended by the vapor barrier manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

3.3 INSTALLATION - GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- C. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

- D. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with mechanical anchorage to provide permanent placement and support of units.
- B. Set vapor retarder faced units with vapor retarder to warm side in winter location of construction, unless otherwise indicated.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- C. Blanket: Install batt insulation in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3 inch clearance of insulation around recessed lighting fixtures.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically by wire or strapping space not more than 2 feet on center and support faced blankets by taping flanges of insulation to flanges of metal studs.
- D. Board: Install board insulation in curtain wall construction where indicated on Drawings according to curtain wall manufacturer's written instructions.
 - 1. Retain insulation in place by metal spindle type anchors spaced at intervals in accordance with the insulation manufacturer print installation instructions to hold insulation securely in place. Maintain space width of dimension indicated between substrate material and insulation.
- E. Stuff loose fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 50 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

3.5 INSTALLATION OF RIGID FOUNDATION INSULATION BOARD

A. Application Methods (one of the following):

1. Spot Method: Apply spots of adhesive (approximately 1 inch diameter x 3/4 inch high) located about 8 inches to 12 inches o.c. alternatively spaced beginning at a corner of the board. (Larger spots may be required to compensate for uneven or irregular wall surfaces.) Install board within the time limit allowed by the adhesive.
2. Ribbon Application Method: Using mechanical applicator, such as hand caulking gun or pneumatic dispenser, extrude ribbons 6 inches in length, 12 inches o.c. the full length of board. Apply 3 lines of ribbons on the board, one along centerline and the other two about 3 inches in from the long edges. Apply ribbons a nominal 5/16 inch in diameter. Install board within the time limit allowed by the adhesive.

- #### B. Installation on Foundation Walls: Place foundation insulation boards specified over areas and against foundation walls where indicated. Adhere vertical boards to surfaces with adhesive using spot method or ribbon application method hereinbefore specified. Lay horizontal boards loose over moisture barrier provided by others. Place insulation boards with closely butted joints over the entire area to be insulated.

3.6 INSTALLATION OF VAPOR BARRIER

- #### A. Install and seal in accordance with ASTM E 1643 and the vapor barrier manufacturer's written instructions.

3.7 PROTECTION

- #### A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 81 16

CEMENTITIOUS SPRAYED-ON FIREPROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Cementitious sprayed-on fireproofing, including the following:
 - 1. Concealed standard density fireproofing.
 - 2. Exposed medium and high density portland cement fireproofing.
 - 3. Application materials as required by conditions of construction to complete the fireproofing installation.

1.2 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
 - 2. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method and shall not require a load restriction factor.
- D. Bond Strength: Minimum 150-lbf/sq. ft. cohesive and adhesive strength based on field testing according to ASTM E 736.
- E. Asbestos: Provide products containing no detectable asbestos.
- F. Engineering Judgment: For those fireproofing applications shown for which no UL tested design is available through a manufacturer, an engineering judgment derived from similar UL system designs or other tests is to be obtained and submitted to local authorities having jurisdiction for their review and approval prior to installation. Submit documentation to substantiate such review and approval.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Conduct at Project site.
 - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each sprayed applied fireproofing product specified.
- B. Shop Drawings: Structural framing plans indicating the following:
 - 1. Locations of surface preparations required before applying fireproofing.
 - 2. Extent of sprayed applied fireproofing for each different construction and fire-resistance rating including the following:
 - a. Applicable fire-resistive design designations of UL testing.
 - b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
 - c. Base design designations on unrestrained members or submit designation of restrained and unrestrained conditions based on definitions in ASTM E 119, Appendix X3 as determined by a Structural Engineer licensed in Illinois.
- C. Schedule: In lieu of shop drawings, submit the following:
 - 1. Fireproofing schedule indicating each column, girder, beam, truss, joist, floor deck and roof deck member or assembly to be fireproofed, include: size of member, required fire rating on member or assembly, U.L. design test no., thickness of material and finish required by location.
 - 2. Indicate structural members which do not meet the minimum size requirements for a listed design, show calculations for required rating on beam, column or other structural member.
- D. Samples: Submit manufacturer's standard samples for each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Signed by manufacturer of sprayed fire-resistive material certifying that the products furnished comply with requirements.

- B. Engineering Judgment: Copies of engineering judgment review and approval by local authorities having jurisdiction for fireproofing applications for which no UL tested design is available.
- C. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- D. Compatibility and Adhesion Test Reports: If used on the project, for primers and other coatings applied to structural steel. Provide reports from a qualified independent testing and inspecting agency engaged by Contractor. Confirm that primers and coatings proposed for application in shop or field are compatible with fire-resistive material. Instruct laboratory to determine compatibility according to requirements specified in "Quality Assurance" Article.
- E. Product Test Reports: Indicate that physical properties of proposed sprayed fire-resistive materials comply with specified requirements based on comprehensive testing of current product formulations by a qualified testing and inspecting agency.
 - 1. Independent laboratory test reports of physical properties
 - 2. U.L. Test Reports.
- F. Warranties: Copy of warranties or terms specified in this Section.

1.6 QUALITY ASSURANCE

- A. Provide cementitious sprayed-on fireproofing and its installation conforming to applicable federal/state and local building codes and regulations.
- B. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- C. Material Qualifications: Provide sprayed material which has been tested and classified for use by Underwriters Laboratories, Inc., to meet required ratings, performance and specified physical properties and conforms to the applicable requirements of the local building code and authorities having jurisdiction. Provide products, execution and thickness conforming to tested U.L. Designs as published in the current Fire Resistance Directory, U.L. Labs, Inc.
- D. Single-Source Responsibility: Obtain sprayed applied fireproofing materials from a single manufacturer for each different product required.

- E. Provide fireproofing products containing no detectable asbestos as determined according to the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, Polarized Light Microscopy.
- F. Testing for Compatibility and Adhesion: Engage a qualified testing and inspecting agency to prepare compatibility and adhesion test reports required in "Submittals" Article based on testing that complies with the following requirements:
 - 1. Testing for bond per ASTM E 736 and requirements specified in UL's "Fire Resistance Directory" about coating materials.
 - 2. Verify that manufacturer of fire-resistive material has not found primers or coatings to be incompatible with fire-resistive material based on its own laboratory testing or field experience.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, unopened packages bearing name of manufacturer and product identification. Reject damaged packages found unsuitable for use and remove from job site. Store materials above ground, under cover and away from damp surfaces. Keep materials dry.

1.8 PROJECT/SITE CONDITIONS

- A. Environmental Conditions: Do not apply sprayed fireproofing when temperature of substrate material is below 40 deg F, and surrounding air temperature is below 40 deg F, except as approved by the manufacturer in writing. Maintain 40 deg F, ambient air and substrate temperature for 24 hours before, during and after application of the sprayed fireproofing.
- B. Protection: Provide ventilation in space to receive sprayed material, introducing fresh air and exhausting air continuously during and 24 hours after application to maintain nontoxic, unpolluted, safe working area. Provide temporary enclosures to prevent spray from contaminating air. Protect adjacent surfaces and equipment from damage by overspray, fall-out and dusting-off of sprayed materials. Provide fire extinguisher and post caution signs warning against smoking and open flame when working with flammable materials.

1.9 SAMPLE APPLICATION

- A. Install a sample of sprayed material approximately 10 sq. ft. for review by the Architect. Include in sample application typical columns, beams, girders and decking if specified to be fireproofed. Provide material finish complying with project requirements as to density and finish where exposed to view.

1.10 MOCKUP APPLICATION – EXPOSED TO VIEW FIREPROOFING

- A. At the start of work, install a mockup sample of sprayed material approximately 10 sq. ft. for each type of fireproofing to be review by the Architect. The mockup installation will be at the site, at a location as mutually agreed upon by the Architect and the Installer. Include in sample application typical columns, truss, beams, girders and decking if specified to be fireproofed. Provide material finishes complying with project requirements as to density and finish where exposed to view. Notify the Architect 48 hours I advance of mockup review. Do not proceed with work until review of mockup sample has been completed by the Architect.
- B. After review of the mockup, its location will be recorded and it will be retained and used as a standard of quality for the remainder of the fireproofing application.
- C. The Architect's review of the mockup sample installation will be for final acceptance of material finish appearance, conformance with design and general quality does not relieve the installer from the responsibility and conformance with herein specified requirements.

1.11 TESTING SERVICES

- A. The Testing Laboratory will be responsible for conducting and interpreting tests, state in each report whether or not the test specimens conform to requirements of the Contract Documents and specifically note any deviation therefrom.
- B. General requirements for testing are specified in Section 01 40 00. Specific test and inspection requirements are specified herein.

1.12 WARRANTY

- A. Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace fireproofing that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of fireproofing from substrates.
 - b. Not covered under the warranty are failures due to damage by occupants and maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
- B. Warranty Period: 2 years from date of Substantial Completion.
- C. This warranty is in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

- A. GCP Applied Technologies Inc., Cambridge, MA 02140.
- B. Carboline, St Louis, MO 63144.
- C. Isolatek International (Cafco), Stanhope, NJ 07874.

2.2 SYSTEMS

- A. Basis of Design: This specification is based upon the products and installation procedures and U.L. Designs of "Monokote" (GCP Applied Technologies Inc.). Comparable products, installation procedures and U.L. Designs of the acceptable named manufacturer's and products will be acceptable subject to the Architect's review. Indicate the specified U.L. Designs and the comparable product on submittals to the Architect.
1. "Monokote" (GCP Applied Technologies Inc.):
 - a. "Monokote Type MK-6".
 - b. "Monokote Type MK-6HY".
 2. "Type 5GP" (Southwest Products, Carboline).
 3. "Cafco 300" (Isolatek, Cafco)
- B. Exposed Areas:
1. Medium Density Portland Cement:
 - a. "Monokote Z-106" (GCP Applied Technologies Inc.).
 - b. "Pyrocrete 239" (Carboline).
 - c. "400" (Cafco).
 2. High Density Portland Cement:

- a. "Monokote Z-146" (GCP Applied Technologies Inc.).
- b. "Pyrocrete 40" (Carboline).
- c. "Fendolite M-II" (Cafco).

2.3 MATERIALS

- A. Concealed Fireproofing: Factory compounded mixture of cementitious material and integral inorganic binders containing no asbestos.
- B. Exposed Fireproofing: Factory compounded mixture of cementitious material and or Portland Cement with integral inorganic binders containing no asbestos.
- C. Physical Properties: Provide fireproofing materials when tested in accordance with the referenced ASTM, meeting the following minimum physical properties:
 1. Minimum Density (ASTM E 605):
 - a. Concealed – Standard Density: 15 pounds per cubic foot average.
 - b. Exposed Medium Density: 22 pounds per cubic foot
 2. Minimum Compressive Strength (ASTM E 761):
 - a. Concealed - Standard Density: Minimum 10 pounds per square inch
 - b. Exposed - Medium Density: Minimum 100 pounds per square inch
 3. Minimum Bond Strength (ASTM E 736):
 - a. Concealed - Standard Density: Minimum average 200 pounds per square foot and a minimum individual 150 pounds per square foot
 - b. Exposed - Medium Density: Minimum average 2000 pounds per square foot and a minimum individual 1500 pounds per square foot
 4. Air Erosion (ASTM E 859):
 - a. Concealed - Standard Density: Maximum .000 grams per square foot
 - b. Exposed - Medium Density: Maximum .005 grams per square foot
 5. Corrosion (ASTM E 937): Does not contribute to corrosion of steel.
 6. Bond Impact (ASTM E 760): No cracking, spalling or delamination.
 7. Deflection (ASTM E 759): No cracking, spalling or delamination.
 8. Surface Burning (ASTM E 84):
 - a. Flame: 0
 - b. Smoke: 0
 9. Combustibility (ASTM E 1356 or E 1354): Noncombustible
 10. Fungal Resistance: No observed growth on specimens when tested in accordance with ASTM G 21.
- D. Water: Clean, free of deleterious substances.
- E. Adhesive: Manufacturer's standard with U.L. noncombustible label.

- F. Sealer: Manufacturer's standard coating to be applied to fireproofing which is to be permanently exposed on the building exterior.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces, conditions and subsequent construction of the installation prior to application. Installation of sprayed-on fireproofing and related materials constitutes acceptance of the existing conditions and construction.
 - 1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 - 2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- B. Verify that concrete work on steel deck is complete before beginning fireproofing work.
- C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.
- D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.

- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.
- E. Fill voids and cracks in substrate, remove projections and level offsets in locations where sprayed material is exposed to view as a finish material.
- F. Clean substrate of dirt, dust, grease, oil, loose particles, frost or other matter which would affect bond of other sprayed material.
- G. Assure that clips, hangers, supports, sleeves and other items required to penetrate the sprayed material are in place before applying the material. Verify that ducts, piping, equipment or other items which would interfere with application of the sprayed material are not positioned until the spraying work is completed.

3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
 - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.

2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
- J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- L. Cure fireproofing according to fireproofing manufacturer's written instructions.
- M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- N. Finishes: Where indicated, apply fireproofing to produce the following finishes:
 1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
 2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
 3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
 4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.
 5. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the Authority Having Jurisdiction.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
 - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIR

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at the time of Substantial Completion.
- C. Coordinate application of fire-resistive material with other construction to minimize the need to cut or remove fire protection. As installation of other construction proceeds, inspect fire-resistive material and patch any damaged or removed areas.
- D. Provide patching and repairing of sprayed fireproofing damaged after application under the work for this section.

END OF SECTION

SECTION 07 84 13

PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

- A. Penetration firestopping, including but not limited to the following:
 - 1. Penetrations in fire-resistance-rated horizontal assemblies.
 - 2. Penetrations in fire-resistance-rated walls and partitions.
 - 3. Penetrations in smoke barriers.

1.2 PERFORMANCE REQUIREMENTS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Approvals in its "Building Materials Approval Guide."
- C. For penetration firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant penetration firestopping.
 - 2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide penetration firestopping capable of supporting the floor loads involved either by installing floor plates or by other means.

3. For penetrations involving insulated piping, provide penetration firestopping not requiring removal of insulation.
- D. For penetration firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E 84.
- E. Systems and Product Selection:
 1. Unless otherwise indicated on the Drawings, select systems and products which are appropriate for the types of penetrations, construction systems and the required fire resistance ratings shown on the Drawings and which comply with the requirements of this specification.
 2. Proprietary products and UL designs when indicated on the Drawings are not intended to imply that products and UL designs of the manufacturer are required to the exclusion of equivalent products of other named acceptable manufacturers.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.
- C. Pre-installation Meeting: Meet with Installer, Architect, firestopping manufacturer's technical representative, if so requested, and other trades involved in coordination with firestopping work at the Project Site. Review procedures and time schedule proposed for installation of penetration firestopping in coordination with other work. Review each major penetration firestopping application required on the Project.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Schedule: For each type of penetration and construction submit a schedule indicating the following:
 1. Location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

2. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
- C. Samples: Submit manufacturer's standard color samples for selection by Architect for exposed to view penetration firestopping.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Literature: Materials description and installation instructions/specifications for materials used in the system.
- B. Certification by penetration firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.
- C. Product Certificates: Signed by manufacturers of penetration firestopping products certifying that their products comply with specified requirements.
- D. Product Test Reports: From a qualified testing and inspecting agency indicating compliance penetration firestopping complies with requirements based on comprehensive testing of current products.
- E. Installer Qualifications:
 1. Submit written evidence in accordance with the "Quality Assurance" article to demonstrate capabilities and experience. Include list of completed projects with project names, addresses, names of Architect and Owners, and other information specified.
 2. Installer's written certification from the Manufacturer stating that the Installer is approved and is a Certified or Licensed Installer of the proposed penetration firestopping.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

- B. Single-Source Responsibility: Obtain penetration firestopping for each type of penetration and construction condition indicated from a single manufacturer.

1.7 TESTING SERVICES

- A. The Owner will employ and pay a qualified inspection agency to test and inspect installed penetration firestopping for compliance with requirements.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver penetration firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi component materials.
- B. Store and handle penetration firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.
 - 1. Store materials, between 60 deg F and 80 deg F. If exposed to lower temperature, restore to proper temperature before using.
 - 2. Store materials, in dry area and protect. Replace damaged materials at Contractor's expense.

1.9 PROJECT/SITE CONDITIONS

- A. Environmental Conditions:
 - 1. Do not proceed with installation of penetration firestopping under adverse environmental conditions or when temperatures are outside the manufacturer's recommended limits.
 - 2. Proceed with the Work only when forecasted environmental conditions are favorable for proper cure and development by ambient temperature variations, install elastomeric sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
- B. Ventilation: Ventilate penetration firestopping installation area per penetration firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

1.10 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's inspecting agency at least seven days in advance of penetration firestopping installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up penetration firestopping installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the specified requirements, provide systems products by one of the following:
 - 1. 3M Fire Protection Products, St. Paul, MN 55144
 - 2. Hilti Construction Chemicals, Inc., Tulsa, OK 74146
 - 3. The RectorSeal Corporation, Houston, TX 77023
 - 4. United States Gypsum Co., Chicago. IL 60680
 - 5. Specified Technologies Co., Sommerville, Nj 08876
 - 6. A/D Fire Protection Systems Inc., Scarborough, ON M1B 1Y4.
 - 7. NUCO Industries, Lake Forest, IL 60045
 - 8. Tremco; Cleveland, OH 44104

2.2 PENETRATION FIRESTOPPING - GENERAL

- A. Compatibility: Provide penetration firestopping that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating penetration firestopping, under conditions of service and application, as demonstrated by penetration firestopping manufacturer based on testing and field experience.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Accessories: Provide components for each penetration firestopping that is needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by the penetration firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Provide accessories which include but are not limited to the following items:
1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 FILL MATERIALS

- A. General: Provide penetration firestopping containing the types of fill materials indicated in the Penetration firestopping Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized steel sheet.
- F. Intumescent Putties: Non-hardening dielectric, water-resistant, intumescent, putties containing no solvents, inorganic fibers, or silicone compounds.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- H. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- I. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of penetration firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Application or installation of material constitutes acceptance of the substrate.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings and joints immediately prior to installing penetration firestopping to comply with recommendations of penetration firestopping manufacturer and the following requirements:
 - 1. Remove foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended by penetration firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping materials from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from penetration firestopping materials. Remove tape as soon as it is possible to do so without disturbing penetration firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Comply with the penetration firestopping manufacturer's installation instructions and drawings pertaining to products and applications indicated.

- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated penetration firestopping.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestop systems.
- C. Install fill materials for penetration firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.5 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words: "Warning--Penetration Firestopping--Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Penetration firestopping designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Penetration firestopping manufacturer's name.
 6. Installer's name.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure penetration firestopping are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated penetration firestopping immediately and install new materials to produce penetration firestopping complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Penetration Firestopping Systems with No Penetrating Items: Comply with the following:
1. Available UL-Classified Systems: C-AJ- 0001-0999.
- C. Penetration Firestopping Systems for Metallic Pipes, Conduit, or Tubing: Comply with the following:

1. Available UL-Classified Systems: C-AJ- 1001-1999.
- D. Penetration Firestopping Systems for Metallic Pipes, Conduit, or Tubing in Framed Walls: Comply with the following:
 1. Available UL-Classified Systems: W-L- 1001-1999.
- E. Penetration Firestopping Systems for Nonmetallic Pipe, Conduit, or Tubing: Comply with the following:
 1. Available UL-Classified Systems: C-AJ-2001-2999.
- F. Penetration Firestopping Systems for Electrical Cables : Comply with the following:
 1. Available UL-Classified Systems: C-AJ- 3001-3999.
- G. Penetration Firestopping Systems for Cable Trays: Comply with the following:
 1. Available UL-Classified Systems: C-AJ-4001-4999.
- H. Penetration Firestopping Systems for Insulated Pipes: Comply with the following:
 1. Available UL-Classified Systems: C-AJ-5001-5999.
- I. Penetration Firestopping Systems for Insulated Pipes in Framed Walls: Comply with the following:
 1. Available UL-Classified Systems: W-L-5001-5999.
- J. Penetration Firestopping Systems for Miscellaneous Electrical Penetrants: Comply with the following:
 1. Available UL-Classified Systems: C-AJ-6001-6999.
- K. Penetration Firestopping Systems for Miscellaneous Electrical Penetrants in Framed Walls: Comply with the following:
 1. Available UL-Classified Systems: W-L-6001-6999.
- L. Penetration Firestopping Systems for Miscellaneous Mechanical Penetrations: Comply with the following:
 1. Available UL-Classified Systems: C-AJ- 7001-7999.
- M. Penetration Firestopping Systems for Miscellaneous Mechanical Penetrations in Framed Walls: Comply with the following:
 1. Available UL-Classified Systems: W-L- 7001-7999.

- N. Penetration Firestopping Systems for Groupings of Penetrations: Comply with the following:
 - 1. Available UL-Classified Systems: C-AJ-8001-8999.
- O. Penetration Firestopping Systems for Groupings of Penetrations in Framed Walls: Comply with the following:
 - 1. Available UL-Classified Systems: W-L-8001-8999.

END OF SECTION

SECTION 07 84 43
JOINT FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

- A. Joint firestopping, including but not limited to the following:
1. Joints in or between fire-resistance-rated constructions.
 2. Joints at exterior wall/floor intersections.
 3. Joints in smoke barriers.

1.2 PERFORMANCE REQUIREMENTS

- A. Joint Firestopping Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Fire-Test-Response Characteristics:
1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
- C. System and Product Selection: Unless otherwise indicated on the Drawings, select systems and products which are appropriate for the types of penetrations, construction systems and the required fire ratings as shown on the Drawings, complying with the requirements of this specification.

1. ADMINISTRATIVE REQUIREMENTS

- D. Pre-installation Meeting: Meet with Installer, Architect, firestopping manufacturer's technical representative, if so requested, and other trades involved in coordination with firestopping work at the Project Site. Review procedures and time schedule proposed for installation of joint firestopping in coordination with other work. Review each major joint firestopping application required on the Project.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of joint firestopping, signed by product manufacturer.
- C. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain joint firestopping for each kind of joint and construction condition indicated through one source from a single manufacturer.
- B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver joint firestopping products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for joint firestopping to prevent deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping when ambient or substrate temperatures are outside limits permitted by joint firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate joint firestopping per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping is installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate joint firestopping.
- C. Notify Owner's inspecting agency at least seven days in advance of joint firestopping installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up joint firestopping installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

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

1. Joint firestopping:
 - a. 3M Fire Protection Products, St. Paul, MN 55144.
 - b. Hilti Construction Chemicals, Inc., Tulsa, OK 74146.
 - c. The RectorSeal Corporation, Houston, TX 77023.
 - d. Nelson Firestop Products, a brand of Emerson Industrial Automation, Tulsa, OK 74145.
 - e. Specified Technologies Co., Sommerville, NJ 08876.
 - f. NUCO Industries, Lake Forest, IL 60045.
 - g. Thermafiber, Inc., an Owens Corning company, Wabash, IN 46992.
 - h. Tremco; Cleveland, OH 44104.
 - i. ROXUL Inc.
 - j. A/D Fire Protection Systems Inc.

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Compatibility: Provide joint firestopping that is compatible with joint substrates, under conditions of service and application, as demonstrated by joint firestopping manufacturer based on testing and field experience.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.
 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
 1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- F. Accessories: Provide components of joint firestopping, including primers and forming materials, that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by joint firestopping manufacturer and approved by the qualified testing and inspecting agency for conditions indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Application or installation of material constitutes acceptance of the substrate.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing joint firestopping to comply with joint firestopping manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Use masking tape to prevent fill materials of joint firestopping from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from joint firestopping materials. Remove tape as soon as possible without disturbing joint firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install joint firestopping to comply with Performance Requirements and joint firestopping manufacturer's written installation instructions.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing Work, tool sealants to form smooth, uniform surface of flush configuration.
- 4. IDENTIFICATION
- D. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.4 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping manufacturers and that do not damage materials in which openings occur.

- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping is without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping immediately and install new materials to produce joint firestopping complying with specified requirements.

1. JOINT FIRESTOPPING SYSTEM SCHEDULE

- C. Where UL-classified joint firestopping systems are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

- D. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under product category Expansion/Seismic Joints or Firestop Systems.

- E. Where UL-classified joints at exterior curtain-wall/floor intersections are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHDG.

- F. Floor-to-Floor, Joint Firestopping System:

1. UL-Classified Products:
 - a. Movement: FF-D-0999
 - b. No Movement: FF-S-0999
2. Assembly Rating: 1 hour / 2 hours
3. Nominal Joint Width: As indicated on Drawings, if not indicated, provide joint width not more than 1/2 inch.
4. Movement Capabilities: Class II

- G. Floor-to-Wall, Joint Firestopping System:

1. UL-Classified Products:
 - a. Movement: FW-D-0999
 - b. No Movement: FW-S-0999
2. Assembly Rating: 1 hour / 2 hours
3. Nominal Joint Width: As indicated on the Drawings, if not indicated, provide joint width not more than 1/2 inch.
4. Movement Capabilities: Class II

- H. Head-of-Wall, Joint Firestopping System:

1. UL-Classified Products:
 - a. Movement: HW-D-0999

- b. No Movement: HW-S-0999
 - 2. Assembly Rating: 1 hour / 2 hours
 - 3. Nominal Joint Width: As indicated on the Drawings, if not indicated, provide joint width not more than 1 inch.
 - 4. Movement Capabilities: Class II
- I. Wall-to-Wall, Joint Firestopping System:
- 1. UL-Classified Products:
 - a. Movement: WW-D-0999
 - b. No Movement: WW-S-0999
 - 2. Assembly Rating: 1 hour / 2 hours
 - 3. Nominal Joint Width: As indicated on the Drawings, if not indicated, provide joint width not more than 1/2 inch.
 - 4. Movement Capabilities: Class II
- J. Bottom-of-Wall, Joint Firestopping System:
- 1. UL-Classified Products:
 - a. Movement: BW-D-0999
 - b. No Movement: BW-S-0999
 - 2. Assembly Rating: 1 hour / 2 hours
 - 3. Nominal Joint Width: As indicated on the Drawings, if not indicated, provide joint width not more than 1 inch.
 - 4. Movement Capabilities: Class II
- K. Perimeter Joint Firestopping System:
- 1. UL-Classified Products:
 - a. No Movement: CW-S-2001
 - b. Movement: CW-D-XXXX
 - 2. Integrity Rating: 1 hour
 - 3. Insulation Rating: 3/4
 - 4. Linear Opening Width: As indicated on the Drawings, if not indicated, provide joint width not more than 2-1/2 inches.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

- A. Joint sealants and installation accessories, including the following:
1. Silicone joint sealants.
 2. Urethane joint sealants.
 3. Latex joint sealants.
 4. Preformed joint sealants.
 5. Acoustical joint sealants.
 6. Specialty sealants for garage floor slabs.
 7. Installation accessories and materials for the above.

1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with stone or masonry substrates.
 4. Submit not fewer than 8 pieces of each kind of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 6. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

7. Testing will not be required if joint sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with, joint substrates and other materials matching those submitted.
- B. Preconstruction Field Adhesion Testing: Before installing sealants, field test their adhesion to project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 2. Conduct field tests for each kind of sealant and joint substrate.
 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to ASTM C 1193, Appendix X1, Method A - Field-Applied Sealant Joint Hand Pull Tab, or ASTM C 1521, Method A - Tail Procedure.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION 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. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2 inch wide joints formed between two 6 inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint Sealant Schedule: Include the following information:
 - 1. Joint sealant application, joint location, and designation.
 - 2. Joint sealant manufacturer and product name.
 - 3. Joint sealant formulation.
 - 4. Joint sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
 - 1. Joint-sealant location and designation.
 - 2. Manufacturer and product name.
 - 3. Type of substrate material.
 - 4. Proposed test.
 - 5. Number of samples required.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Preconstruction Laboratory Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Preconstruction Field Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- G. Field Adhesion Test Reports: For each sealant application tested.

H. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Comply with the applicable portions of ASTM C 1193 - Standard Guide for Use of Joint Sealants for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint sealant installations with a record of successful in-service performance.
- C. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- D. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- E. 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.

1.7 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.

PART 2 PRODUCTS

2.1 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. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40CFR59, Part 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- 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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 JOINT SEALANTS

- A. S-2: Single Component, Nonsag Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT. Subject to compliance with requirements, provide one of the following:
 - 1. "Dynatrol I-XL" (Pecora Corporation).
 - 2. "Sikaflex - 1a" (Sika Corporation, Construction Products Division).
 - 3. "Dymonic and Vulkem 116" (Tremco Incorporated).
 - 4. "Masterseal NP1" (BASF).
- B. S-3: Multicomponent, Nonsag Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T. Subject to compliance with requirements, provide one of the following:
 - 1. "Dynatred" (Pecora Corporation).
 - 2. "Sikaflex - 2c NS" (Sika Corporation, Construction Products Division).
 - 3. "Masterseal NP2" (BASF).

4. "Vulkem 227" (Tremco Incorporated).
- C. S-4: Acrylic Latex or Siliconized Acrylic Latex Joint Sealant: ASTM C 834, Type OP, Grade NF. Subject to compliance with requirements, provide one of the following:
1. "AC-20+" (Pecora Corporation).
 2. "Tremflex 834" (Tremco Incorporated).
 3. "Masterseal 520" (BASF).
- D. S-5: Single Component, Nonsag Neutral Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT. Subject to compliance with requirements, provide one of the following:
1. "790" (Dow Corning Corporation).
 2. "SilPruf LM SCS2700" (GE Advanced Materials – Silicones).
 3. "Spectrem 1" (Tremco Incorporated).
 4. "890NST" (Pecora Corporation).
- E. S-6: Single Component, Nonsag Neutral Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50/50, for Use NT and nonstaining to porous substrates per ASTM C 1248. Subject to compliance with requirements, provide one of the following:
1. "Spectrem 3" (Tremco, Inc.).
 2. "756 SMS" (Dow Corning Corporation).
 3. "SCS9000 SilPruf NB" (GE Construction Sealants).
 4. "864NST", "895NST", or "898NST" (Pecora Corporation).
- F. S-7: Single Component, Nonsag, Neutral Curing Silicone Joint and Structural Glazing Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT. Subject to compliance with requirements, provide one of the following:
1. "799" (Dow Corning Corporation).
 2. "UltraGlaze SSG4000" (GE Advanced Materials – Silicones).
 3. "Proglaze SSG" (Tremco Incorporated).
- G. S-8: Mildew Resistant, Single Component, Acid Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT. Subject to compliance with requirements, provide one of the following:
1. "786 Mildew Resistant" (Dow Corning Corporation).
 2. "Sanitary SCS1700" (GE Advanced Materials – Silicones).
 3. "Tremsil 200 Sanitary" (Tremco Incorporated).
 4. "898NST" (Pecora Corporation).

- H. S-9: Butyl sealant: material with a movement capability of plus or minus 5 percent, conforming to ASTM C 1085.
1. "Butyl Rubber Sealant BC-158" (Pecora Corp.).
 2. "PTI 757" (H. B. Fuller Company).
 3. "Tremco Butyl Sealant" (Tremco, Inc.).
- I. S-10: Polyurea Joint Sealant: Two-part, fast setting, self-leveling, 100 percent solids, semi-rigid, for sealing parking garage floor slab, saw-cut, construction and control joints:
1. "Euco QWIK Joint 200" (Euclid).
 2. "Masterseal CR 100" (BASF).
- J. S-11: 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 E90. Subject to compliance with requirements, provide one of the following:
1. "AC-20 FTR or AIS-919" (Pecora Corporation).
 2. "SHEETROCK Acoustical Sealant" (USG Corporation).
 3. "Acoustical Sealant" (Tremco, Inc.).
- K. Acoustical Sealant for Fire Rated Partitions: refer to Section 07 84 43 Joint Firestopping.

2.3 PREFORMED JOINT SEALANTS

- A. Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of precured low modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral curing silicone sealant for bonding extrusions to substrates. Subject to compliance with requirements, provide one of the following:
1. "123 Silicone Seal" (Dow Corning Corporation).
 2. "UltraSpan US1100" (GE Advanced Materials – Silicones).
 3. "Sil-Span" (Pecora Corporation).

- B. Preformed Compressible Seals: Preformed, precompressed, impregnated open cell foam sealant manufactured from high density urethane foam impregnated with a nondrying, water repellent agent; factory produced in precompressed sizes and in roll form to fit joint widths indicated on the Drawings and to develop a watertight and airtight seal when compressed to the degree specified by manufacturer; neoprene rubber suspended in water based emulsion, density 9-10 pcf, with pressure sensitive adhesive factory applied to one side with protective wrapping. Subject to compliance with requirements, provide one of the following:
1. "Emseal 25V" (EMSEAL Joint Systems, Ltd.).
 2. "Wilseal 600" (illbruck Sealant Systems, Inc.).
 3. "Polytite Standard" (Polytite Manufacturing Corporation).

2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, and primers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, type and material as recommended and 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 materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

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

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 - 1. Remove 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. Remove laitance and form release agents from concrete.
 - 3. 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.
- B. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer or as indicated by preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of 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 complying with ASTM C 1193, Figure 8A, unless otherwise indicated.
 - 4. Provide flush joint profile complying with ASTM C 1193, Figure 8B.
 - 5. Provide recessed joint configuration of recess depth and at locations complying with ASTM C 1193, Figure 8C.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

- G. Installation of Preformed Silicone Sealant System: Comply with the following requirements:
1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.
- I. 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.

3.4 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 10 tests for the first 1,000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1,000 feet of joint length thereafter or one test per each floor per elevation.
 2. Test Method: Test joint sealants according to ASTM C 1193, Appendix X1, Method A - Field-Applied Sealant Joint Hand Pull Tab, or ASTM C 1521, Method A - Tail Procedure.

- 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.

3.5 CLEANING

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

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT SEALANT SCHEDULE

- A. S-5
- B. S-7
- C. S-2, S-3 and S-6
- D. S-10
- E. S-2, S-3 and S-5
- F. S-4
- G. S-9
- H. S-8
- I. S-11

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

- A. Hollow metal doors and frames, including fabrication and installation accessories.

1.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 3. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
- B. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. when tested according to ASTM C 518.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

- A. Product Data: Copies of manufacturer's data for fabrication and installation instructions.
- B. Shop Drawings:
 - 1. Submit shop drawings for the fabrication and installation. Include details of each frame type, elevations of door design types, conditions at openings, details of anchorage to construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections.
 - 2. Provide a schedule of doors and frames using same reference numbers for details and openings as those on the Contract Document Drawings. Indicate fire-rated doors and frames, welded and knockdown frames.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Certification: When door assemblies required to be fire-rated that exceed manufacturer's capabilities or UL design maximum sizes, submit copies of Door and Frame Manufacturer's Label Certification that each door and frame assembly has been constructed to conform to design, materials and construction equivalent to the requirements for labeled assemblies or products or units tested in accordance with ASTM E 2074.

1.6 QUALITY ASSURANCE

- A. Products: Provide custom welded hollow steel doors and frames by a single firm specializing in the production of custom hollow steel work as evidenced by a minimum of 10 consecutive years production experience.
- B. Provide custom hollow steel doors and frames conforming to the applicable recommended practices contained in the following:
 - 1. Custom:
 - a. National Association of Architectural Metal Manufacturer's (NAAMM) "Hollow Metal Technical and Design Manual", except as hereafter modified.
 - b. National Association of Architectural Metal Manufacturers (NAAMM) "Guide Specifications for Commercial Hollow Metal Doors and Frames", ANSI/NAAMM HMMA 861, except as herein modified.

2. Standard: Steel Door Institute (SDI), Standard Steel Doors and Frames, SDI 100/ANSI/SDI A250.8, Recommended Specifications, except as herein modified.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Inspection: Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided the finish items are equal to new work; otherwise, remove and replace damaged items as directed.
- B. Storage: Store at the building site under cover. Place units on at least 4 inch high wood sills or on floors in a manner that will prevent rust and damage. Avoid the use of non-vented plastic or canvas shelters, which could create a humidity chamber. If the cardboard wrapper on the door becomes wet, remove the carton immediately. Provide a 1/4 inch space between stacked doors to promote air circulation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide hollow metal work by one of the following:
 1. Ceco Door Products; an Assa Abloy Group company.
 2. Curries Company; an Assa Abloy Group company.
 3. Steelcraft; an Allegion company.
 4. Republic Doors and Frames.

2.2 MATERIALS

- A. Hot-Rolled Steel Sheets and Strips: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 1011/ A 1011 M and ASTM A 568/ A 568M.
- B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 1008/ A 1008M and ASTM A 568/ A 568M.
- C. Metallic Coated Steel Sheets (Exterior Door Faces and Channels, Door Frames): ASTM A 653/ A 653M Commercial Steel (CS), Type B, with an A60 zinc-iron-alloy (galvannealed) coating; stretcher leveled standard of flatness.
- D. Electrolytic Zinc Coated Steel Sheet: ASTM A 591/ A 591M, Commercial Steel (CS), Class B coating; mill phosphatized; suitable for unexposed applications; stretcher leveled standard of flatness where used for face sheets.

- E. Structural Steel Shapes: ASTM A 36/ A 36M.
- F. Steel Bars: ASTM A 108.
- G. Steel Plate: ASTM A 283/ A 283M.
- H. Supports and Anchors: Fabricate of not less than 0.053 inch thick sheet metal. Galvanized after fabrication for units to be built into exterior walls, 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.
- I. Shop Primer: Modified alkyd rust inhibiting primer paint as standard with door and frame fabricator.
- J. Galvanizing Repair Paint: High zinc dust content paint for repairing galvanizing at welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with SSPC-Paint 20.
- K. Galvanized Primer: FS TT-P-641F.

2.3 FABRICATION – GENERAL

- A. Fabricate hollow metal units to be rigid, neat in appearance and free from defects, warp, buckle and shadows or surface deformations from welds. Accurately form metal to required sizes and profiles. Wherever practicable, fit and assemble units in the manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at the project site. Weld exposed joints continuously, grind, dress, and make smooth, flush, and invisible.
- B. Prepare hollow metal units to receive finish hardware, including cutouts, reinforcing, drilling and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 Specifications for Door and Frame Preparation for Hardware, current edition.
- C. Locate finish hardware as shown on final shop drawings or, if not shown, in accordance with National Builders' Hardware Association "Recommended Locations for Builder's Hardware", current edition.

2.4 DOOR FABRICATION

- A. Provide full flush design doors, seamless hollow construction. Bevel both vertical edges 1/8 inch.

- B. Fabricate of hot or cold-rolled, stretcher leveled steel sheets. Construct doors with smooth, flush surfaces, continuously welded edge seams without visible joints or seams on exposed faces or stile edges.
- C. Reinforce inside with vertical, hot-rolled steel not less than 0.042 inch thick for interior (SDI - Level 2) and 0.053 inch thick for exterior (SDI - Level 3) steel channel shaped sections or interlocking Z-shaped steel sections. Space vertical reinforcing 6 inches o.c. and extend full door height. Spot weld at not more than 5 inches o.c. to both face sheets.
- D. Interior Doors: SDI - Level 2 - Heavy Duty, Full Flush and Seamless, but not less than the following:
 - 1. Reinforce tops and bottoms of interior doors with 0.042 inch thick horizontal steel channels spot welded at not more than 5 inches o.c. to the outer sheets.
 - 2. Provide not less than 0.042 inch thick steel faces.
 - 3. Provide sound insulation filler of fiberboard, mineral board or other non-combustible material solidly packed full door height to fill the voids between inner core reinforcing members.
 - 4. Fire Door Core: As required to provide hourly fire and temperature rise ratings indicated.
- E. Reinforce doors with rigid tubular frames where stiles and rails are less than 8 inches wide. Form tubular frames with 0.053 inch thick galvanized steel, welded to outer sheets.
- F. Finish Hardware Reinforcement: Unless otherwise indicated herein, reinforce doors for scheduled finish hardware, as follows:
 - 1. Butt Hinges: Steel plate not less than 0.187 inch thick x 1-1/2 inches wide x 6 inches longer than hinge, secured by not less than six spot welds.
 - 2. Continuous Hinges: Steel plate not less than 0.187 inch thick x 1-1/2 inches wide continuous, secured by spot welds 8 inches o.c.
 - 3. Mortise Locksets and Dead Bolts: Not less than 0.067 inch thick steel sheet, secured with not less than two spot welds.
 - 4. Cylindrical Locks: Not less than 0.093 inch thick steel sheet, secured with not less than two spot welds.
 - 5. Flush Bolts: Not less than 0.093 inch thick steel sheet, secured with not less than two spot welds.
 - 6. Surface Applied Closers: Not less than 0.093 inch thick steel sheet, secured with not less than six spot welds.
 - 7. Push Plates and Bars: Not less than 0.053 inch thick steel sheet (except when through bolts are shown or specified), secured with not less than two spot welds

8. Surface Panic Devices: 0.067 inch thick sheet steel (except when through bolts are shown or specified), secured with not less than two spot welds.

2.5 HOLLOW-METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.6 FRAME FABRICATION

A. General:

1. Fabricate frames unless noted otherwise of full welded unit construction, with corners full mitered, reinforced, continuously welded inside the full depth and width of frame miter, including returns, soffits and stops.
2. Knockdown frames will not be acceptable as alternates for welded frames.
3. Form frames of either cold or hot-rolled sheet steel.
4. Interior Frames: Provide not less than 0.053 inch thick steel for interior openings, including 4 feet wide.
5. For openings over 4 feet wide, increase thickness by at least 2 standard thickness.

B. Welded Frame Corner Joints (Full Profile Welded) :

1. Fabricate frame members stamped in the flats to a predetermined pattern, designed to provide mitered faces or trims and mitered stops.
2. After fabricating head and jamb members, fit frames together engaging projecting tabs into corresponding slots in the head.
3. Tightly close contact edges so that trim and faces are aligned straight, level and true.
 - a. Secure interlocking tabs where they pass thru head slots by welding.
 - b. Continuously weld back bends, soffits and returns together.
 - c. Continuously weld mitered trim joints on each side inside the frame section. Dress and finish exposed joints to produce invisible connections.
 - d. Weld head and jamb together along their intersecting depth and width inside the frame.
 - e. Weld jambs to head overhang along the length of each rabbet, inside the frame completely welding the full joint perimeter.
 - f. Grind welds on exposed surfaces smooth and flush with adjoining surfaces.

C. Window Frames, Borrowed Lites, Mullions and Transom Bars:

1. Provide closed or tubular mullions and transom bars. Fasten mullions and transom bars at crossings and to jambs by butt welding. Reinforce joints between frame members with concealed clip angles or sleeves same metal and thickness as frame.
 2. Where installed in masonry, leave vertical mullions in frames open at the top so they can be filled with grout.
 3. Provide steel channel stiffeners on interior of closed mullion sections.
 4. Provide anchors for window and side lites frames same as for doors.
 5. Provide concealed sleeves for frames to be shipped in one piece. Weld and grind smooth field connections.
- D. Welded Frame Jamb Anchors: Furnish jamb anchors as required to secure frames to adjacent construction and as required by fire-rated assemblies, formed of not less than 0.042 inch thick galvanized steel unless noted otherwise.
1. Masonry Construction: Adjustable, flat or corrugated or perforated, T-shaped to suit frame size with leg not less than 2 inches wide, by 10 inches long. Furnish at least three anchors per jamb up to 7 feet-6 inches height; four anchors up to 8 feet jamb height; one additional anchor for each 24 inches or fraction thereof over 8 feet height.
 2. Metal Stud Partitions: Insert type with notched clip to engage metal stud, welded to back of frames. Provide at least four anchors for each jamb for frames up to 7 feet-6 inches in height; five anchors up to 8 feet jamb height; one additional anchor for each 24 inches or fraction thereof over 8 feet height.
 3. In-Place Concrete or Masonry: Fabricate frames jambs to accept minimum 3/8 inch diameter concealed bolts into expansion shields or inserts at 6 inches from top and bottom and 26 inches o.c., unless otherwise shown. Reinforce frames at anchor locations. Provide non-removable snap-on covers over anchor bolts, unless otherwise indicated.
- E. Floor Anchors: Provide floor anchors for each jamb and mullion which extends to floor, formed of not less than 0.067 inch thick galvanized steel sheet; clip type anchors, with two holes to receive fasteners, welded to bottom of jambs.
- F. Structural Reinforcing Members: Provide structural reinforcing members as a part of frame assembly, where indicated at mullions, transoms or other locations which are to be built into frame.
- G. Head Reinforcing: For frames over 4 feet wide in masonry wall openings, provide continuous steel channel or angle stiffener, not less than 0.093 inch thick for full width of openings, welded to back of frame at head, except where not allowable for label requirements.

- H. Finish Hardware Reinforcement: Unless otherwise indicated herein, reinforce frames for scheduled finish hardware, as follows:
1. Butt Hinges and Pivots: Steel plate not less than 0.187 inch thick x 1-1/2 inches wide x 6 inches longer than hinge, secured by not less than six spot welds.
 2. Continuous Hinges: Steel plate not less than 0.187 inch thick x 1-1/2 inches wide x continuous, secured by spot welds 8 inches o.c.
 3. Strike Plate Clips: Steel plate not less than 0.187 inch thick x 1-1/2 inches wide x 3 inch long.
 4. Surface Applied Closers: Not less than 0.093 inch thick steel sheet, secured with not less than six spot welds.
 5. Concealed Closers: Removable steel access plate, not less than 0.093 inch thick internal reinforcement of size and shape required, and enclosing housing to keep closer pocket free of mortar or other materials.
- I. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.
- J. Rubber Door Silencers: Drill stop to receive three silencers on single door frames and four silencers on double door frames. Install plastic lugs to keep holes clear during construction.
- K. Plaster Guards: Provide 0.016 inch thick steel plaster guards or dust cover boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware installation.

2.7 STOPS AND MOLDINGS

- A. Provide stops and moldings around openings in hollow metal door and window units and for frames to receive lights where indicated.
- B. Form fixed stops and moldings integral with door or frame. Provide fixed stops on outside of hollow metal units exposed to exterior and on corridor side of interior units, unless otherwise indicated.
- C. Provide removal stops and molds at other locations, formed of not less than 0.032 inch thick steel sheets. Secure with countersunk machine screws spaced uniformly not more than 1/2 inch o.c. form corners with butted hairline joints.
- D. Coordinate width of rabbet between fixed and removable stops with type of glass or panel and type of installation indicated.

2.8 LOUVERS

- A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.
 - 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
 - 2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.
 - 3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.
- B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

2.9 SHOP PAINTING

- A. Clean surfaces of fabricated units of mill scale, rust, oil, grease, dirt and other foreign matter.
- B. After fabrication, dress, fill and sand tool marks and surface imperfections as required to make faces and vertical edges smooth, level and free of irregularities.
- C. Pretreat cleaned surface in accordance with SSPC-PT-2, SSPC-PT3 or SSPC-PT4. Verify compatibility of primer with galvanized surfaces. Provide primer on galvanized surfaces that will not affect finish paint materials.
- D. Shop Applied Paint:
 - 1. Plain Steel: For steel surfaces, use rust inhibitive enamel or paint, either air drying or baking, suitable as a base for finish paints, complying with ANSI/SDI A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces.
 - 2. Galvanized Steel: Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified to comply with ASTM A 780. After applying repair paint, clean surfaces and apply galvanized metal primer compatible coatings to be applied over it.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install hollow metal units and accessories in accordance with the final reviewed shop drawings, manufacturer's written instructions, and as herein specified.
- B. Setting Masonry Anchorage Devices:
 - 1. Provide masonry anchorage devices where required for securing hollow metal frame to in-place concrete or masonry construction.
 - 2. Set anchorage devices opposite each anchor location in accordance with details on final shop drawings, fire-rated assembly requirements and anchorage device manufacturer's instructions. Leave drilled holes rough, not reamed and free from dust and debris.
- C. Floor Anchors: Floor anchors may be set with power actuated fasteners instead of masonry anchorage devices and machine screws, if so approved by the Architect.
- D. Placing Frames: Comply with 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 and spreaders leaving surfaces smooth and undamaged.
 - 2. For masonry construction, refer to Section 04 20 00 - Unit Masonry.
 - 3. Install fire-rated frames in accordance with NFPA 80.
 - 4. At in-place concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage device.
 - 5. Make field splices in frames as detailed on final shop drawing, welded and finished to match factory work.
 - 6. Remove spreader bars only after frames or bucks have been properly set and secured.
 - 7. Installation Tolerances: Adjust hollow metal door frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

E. Door Installation: Comply with SDI A250.8.

1. Fit hollow metal doors accurately in their respective frames, with the following clearances:
 - a. Jamb and Head: 3/32 inch.
 - b. Meeting Edges, Pairs of Doors: 1/8 inch.
 - c. Bottom: 3/4 inch, where no threshold or carpet (except where scheduled as undercut).
 - d. Bottom: At threshold, carpet or thin-set ceramic tile: Not less than 1/4 inch and not greater than 3/8 inch from floor finish or top of threshold.
2. Install fire-rated doors in accordance with NFPA 80.
3. For hardware refer to Section 08 71 00 - Finish Door Hardware.

3.2 ADJUST AND CLEAN

- A. Final Adjustment: Check and readjust operating finish hardware items in hollow metal work just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise unacceptable.

END OF SECTION

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Interior flush wood doors, including factory fitting and machining for hardware and factory applied transparent finishing.
- B. Related Sections:
 - 1. Hollow metal doors frames: Section 08 11 13.
 - 2. Finish door hardware: Section 08 71 00.
 - 3. Glass: Section 08 80 00.
 - 4. Painting: Section 09 91 00.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show elevations, dimensions, construction details for each type of door.
 - 2. Provide door schedule of doors using same reference numbers for openings as those on the Contract Drawings.
- C. Samples:
 - 1. 12 inch x 12 inch corner section of each type door.
 - 2. 12 inch x 12 inch x 1/4 inch to 3/4 inch thick samples with each veneer specified, without stain or finish.
 - 3. Finish Samples:
 - a. 12 inch x 12 inch x 3/4 inch thick pieces of plywood with each veneer specified with a range of stains for selection by the Architect.
 - b. A maximum of four (4) separate sample sets of 3 may be required to obtain the desired stain color and finish appearance for each finish specified.
 - c. Finish samples as specified and numbered for reference of stain and finish. Include on the back of each sample a complete description of the finish and each coat applied.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer's Literature:

1. Verification that AWI Quality Certification Labels for Project indicate doors comply with requirements of grades specified.

B. Warranty: Signed copies of warranty specified herein.

1.4 QUALITY ASSURANCE

A. Except as otherwise specified herein, provide wood doors conforming with Architectural Woodwork Institute latest standards.

1. Flush Wood Doors: ANSI/WDMA I.S-1A

1.5 DELIVERY, HANDLING AND STORAGE

A. Individually package doors in corrugated cartons and/or poly bags by the manufacturer with identifying marks.

B. Store doors flat with spacers between each door, a minimum of 3 inches off the floor. Do not remove doors from cartons or poly bags until painting and other interior finishing work has been completed. Immediately remove from the project site, damaged or otherwise unsuitable doors, when so ascertained.

1.6 PROJECT SITE CONDITIONS

A. Environmental Requirements: Do not deliver doors until storage areas have been closed in and are thoroughly dry. Do not install wood doors until the required temperature and relative humidity have been stabilized in installation areas per the door manufacturer's requirements.

1.7 WARRANTY

A. Provide door manufacturer's or fabricator's written warranty stating that the wood doors will be free of faults and defects in accordance with the General Conditions, except that the warranty is to be for the life of the installation for solid core doors, instead of one year from the date of Substantial Completion.

- B. Provide warranty signed by the door manufacturer or fabricator. Warp in excess of that permitted by the WDMA or any defect which affects the operation or appearance of the door is considered a defect under the provisions of the warranty.
- C. Provide warranty including the cost of defective door replacement and the cost of rehung defective doors.
- D. The door manufacturer or fabricator or his representative is responsible for inspecting the installation of the doors before issuance of the warranty and is to note on the warranty that the doors have been installed in accordance with the manufacturer's recommendations.
- E. This warranty is in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Solid Core Doors:

- 1. Eggers Hardwood Products Corporation, Two Rivers, WI 54241.
- 2. Assa Abloy Wood Doors, Mason City, IA 50401.
- 3. Masonite Architectural, Tampa, FL 33602.
- 4. Mohawk Flush Doors, Inc., Northumberland, PA 17857.
- 5. VT Industries, Inc., Holstein, IA 51025.

2.2 DOOR CONSTRUCTION – GENERAL

- A. Flush Solid Core Non-Fire Rated Doors: Flush, solid core, hardwood MDO veneered, AWI latest standards, Premium Grade, 5-ply construction, Performance Duty Level: Heavy Duty.
 - 1. Cores: Particleboard core construction, ANSI A208.1, Grade 1-LD-2 1-LD-1, Type A: bonded core.
 - 2. Face Veneers:
 - a. Transparent Finish: (1/40th inch thick before sanding):
 - 1) Wood Species, Veneer Cut: plain sliced white maple to match existing, for transparent finish. 'Gardall' Finish to match sample N2759-18GL by Chicago Doorways. Sample to be provided by Architect.
 - 3. Crossbands: Hardwood, 1/16 inch thick, extending the full width and height of the door.
 - 4. Adhesives: Type I.
 - 5. Stiles:

- a. Vertical: Minimum 1-3/8 inch thick.
- b. Top and Bottom: Minimum 4-1/2 inches wide.
6. Edge Bands: Same species as face veneer.
7. Inner Blocking:
 - a. Top and Bottom: Continuous, minimum 5 inches wide solid wood blocking solid, or wider to assure no through bolting of surface hardware.
 - b. Both Stiles: 5 inch wide x 10 inch long solid wood lock blocking.
8. Thickness: 1-3/4 inches.

2.3 FABRICATION – GENERAL

- A. Factory fit doors to suit frame opening sizes indicated:
 1. Comply with clearance requirements of referenced quality standard for fitting.
- B. Factory machine doors for hardware that is not surface applied.
 1. Locate hardware to comply with DHI WDHS 3.
 2. Comply with final hardware schedules, door frame shop drawings, DHI A115 W series standards, and hardware templates.
 3. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Louvers: Factory install louvers in prepared openings.

2.4 TRANSPARENT FINISHING

- A. Factory finish hardwood veneer doors indicated on the Drawings to receive transparent finishing.
- B. Preparation for finishing and finishing is to conform with AWI latest standards, Premium Grade. Provide finish to match existing.
- C. Seal tops and bottoms of wood door with a heavy coat of varnish or equivalent sealer prior to delivery to the job. Seal vertical edges of doors to receive opaque finishes (paint).

PART 3 EXECUTION

3.1 PREPARATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Starting of work constitutes acceptance of the existing conditions.
- C. Inspect each area of installation and allow doors to acclimate to the area temperature and humidity.

3.2 INSTALLATION

- A. Install flush wood doors in accordance with the manufacturer's printed instructions, referenced standards, the final reviewed shop drawings and this Section.
- B. Carry doors upright. Do not drag doors. Protect door bottoms with scruff strips. Do not slide across one another. Condition doors to average humidity of spaces before hanging.
- C. 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. Machine doors for hardware. Seal cut surfaces after fitting and machining including areas routed for concealed closers and other hardware cutouts. Hand doors with hardware specified.
 - 1. Provide uniform clearances at jambs and heads not to exceed 1/8 inch and at bottoms not less than 1/4 inch nor greater than 3/4 inch and not greater than 3/8 inch from floor finish or top of threshold, except where indicated otherwise on the Drawings to be under cut or where required to clear thresholds, floor finishes or for passage of air. Coordinate undercut requirements with various floor materials and trades installing such and provide undercuts to accommodate conditions for installation of doors at no additional cost to the Owner.
- D. Bevels:
 - 1. Bevel non-rated doors 1/8 inch in 2 inches at lock and hinge edges.

3.3 CLEANING AND PROTECTION

- A. Repair or remove and replace defective doors as directed upon completion of installation. Remove and replace doors which cannot be successfully repaired.
- B. Protection: protect wood until acceptance of the Work by the Owner. Maintain temperature and humidity conditions during the remainder of the construction period to comply with door manufacturer's printed instructions.
- C. Clean door surfaces in accordance with the manufacturer's recommendations. Touch-up factory finished doors in accordance with the manufacturer's printed instructions. Remove and replace doors which cannot be successfully touched-up in the field.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Access doors, including installation accessories.
- B. Related Sections:
 - 1. Non-structural metal framing: Section 09 22 16
 - 2. Gypsum board: Section 09 29 00.
 - 3. Acoustical ceilings: Section 09 51 00
 - 4. Painting: Section 09 91 00.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Plan, elevation and details of construction for each type of door specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Literature: Materials description and installation instructions.
- B. Coordination Drawings: Provide plans drawn to scale coordinating access doors with items of construction, systems and equipment concealed in ceilings and walls requiring access. Include subcontractor signatures certifying coordination.
- C. Certification: Copies certification of UL listing for fire-rated doors.

1.4 QUALITY ASSURANCE

- A. Provide access doors in fire-rated construction complying with UL listed and bearing labels required.
- B. Coordination:
 - 1. Coordinate the required sizes, locations and quantities of access panels with the Mechanical, Electrical, Plumbing and Fire Protection Contractors. Provide coordination drawings signed by Mechanical, Electrical, Plumbing and Fire Protection Contractors certifying coordination.

2. Furnish inserts and anchoring devices to be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Karp Associates, Inc., Maspeth, NY 11378.
- B. Milcor Incorporated, Lima, OH 45804.
- C. Nystrom, Inc., Minneapolis, MN 55413.

2.2 ITEMS

- A. Type I: Flush metal panel, fire-rated access door, 1-1/2 hour B label, for gypsum wallboard construction, one of the following:
 1. Karp, KRP-350FR.
 2. Milcor, UFR DW.
 3. Nystrom, UW.
- B. Type II: Flush metal panel access door for gypsum wallboard construction, one of the following:
 1. Karp, KDW.
 2. Milcor, Style DW.
 3. Nystrom, NW.
- C. Type III: Flush metal panel access door for plaster construction, one of the following:
 1. Karp, DSC-214PL.
 2. Milcor, Style K.
 3. Nystrom, NP.
- D. Type IV: Access door with recess for acoustical ceiling panels or tiles, frameless, one of the following:
 1. Karp, DSC-210.
 2. Milcor, Style AT.
 3. Nystrom, RA.
- E. Type V: Access door with recess for gypsum wallboard finish, one of the following:

1. Karp, RDW.
 2. Milcor, Style DWR.
 3. Nystrom, RW.
- F. Type VI: Access door with recess for plaster finish, one of the following:
1. Karp, DSC-210PL.
 2. Milcor, Style AP.
 3. Nystrom, RP.
- G. Type VII: Flush panel access door with exposed flange for various non-fire-rated constructions, one of the following:
1. Karp, DSC-214M.
 2. Milcor, Style M.
 3. Nystrom, NT.

2.3 FABRICATION

- A. Type I: Flush panel metal, fire-rated access door for gypsum wallboard construction:
1. Provide frames of 16 gage steel; panels of 20 gage steel, sandwich type.
 2. Equip panels with an automatic closing mechanism.
 3. Provide door and frame with factory prime coated with baked enamel over a protective phosphate coating on the steel.
 4. Provide continuous steel hinges with stainless steel pin.
 5. Provide cylinder type lock assembly, self-latching with key operated cylinder lock and having a mechanism to release the latch bolt from the inside.
- B. Type II: Flush metal panel access door for gypsum wallboard construction:
1. Provide frame of 16 gage steel with galvanized steel wallboard bead surrounding frame and panel of 14 gage steel.
 2. Provide door and frame factory prime coated with baked enamel over a protective phosphate coating on the steel.
 3. Provide concealed, spring type hinges opening to 175 degrees.
 4. Provide flush locks with metal cam and be a key operated cylinder lock.
- C. Type III: Flush metal panel access door for plaster construction:
1. Provide frame of 16 gage steel door frame with 22 gage galvanized steel plaster casing surrounding frame and panel of 14 gage steel.
 2. Provide door and frame factory prime coated with baked enamel over a protective phosphate coating on the steel.

3. Provide concealed hinges, spring type, opening to 175 degrees.
 4. Provide flush lock with metal cam and be a key operated cylinder lock.
- D. Type IV: Access door with recess for acoustical ceiling panels or tiles, frameless appearance:
1. Provide frame of 16 gage steel offset to provide for a fully recessed 18 gage steel door fabricated to receive acoustical ceiling panel or tile inserts.
 2. Provide door and frame factory prime coated with baked enamel over a protective phosphate coating on the steel.
 3. Provide continuous pin mounted hinge on longest side opening 180 degrees.
 4. Provide flush screwdriver operated lock with case hardened steel cam lock. Provide plastic grommet to protect hole in acoustical panel or tile for lock.
- E. Type V: Access door with recess for gypsum wallboard finish:
1. Provide frame of 16 gage steel offset to provide for a fully recessed 18 gage steel door fabricated to receive gypsum wallboard inserts.
 2. Provide door and frame factory prime coated with baked enamel over a protective phosphate coating on the steel.
 3. Provide continuous pin mounted hinges on longest side opening 180 degrees.
 4. Provide flush screwdriver operated lock with case hardened steel cam lock. Provide plastic grommet to protect hole in gypsum wallboard for lock.
- F. Type VI: Access door with recess for plaster finish:
1. Provide frame of 16 gage steel with 22 gage galvanized steel plaster casing bead surrounding frame and door panel of 18 gage steel lined with self-furring expanded galvanized metal lath spot welded to the door panel and 22 gage galvanized metal casing beads on four sides of door.
 2. Provide door and frame factory prime coated with baked enamel over a protective phosphate coating on the steel.
 3. Provide concealed hinges, spring type, opening to 175 degrees.
 4. Provide flush screwdriver operated lock with case hardened steel cam lock. Provide plastic grommet to protect hole in plaster for lock.
- G. Type VII: Flush panel access door with exposed flange for various non-fire-rated constructions:
1. Provide frame of 16 gage steel door frame with 14 gage flush steel door.
 2. Provide door and frame factory prime coated with baked enamel over a protective phosphate coating on the steel.
 3. Provide continuous pin mounted hinges on longest side opening 180 degrees.
 4. Provide flush locks, with metal cam and be a key operated cylinder lock.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine surfaces to receive the access doors. Verify dimensions of in-place and subsequent construction. Installation of the access doors shall constitute acceptance of the related construction.

3.2 INSTALLATION

- A. Install access doors as shown, or in the absence of details, in accordance with manufacturer's instructions.
- B. Following installation of the access doors, clean surfaces, lubricate and test operation of moving parts. Make adjustments in operation as necessary.
- C. Deliver keys for access doors to the Owner's Representative with tags identifying each door, its location and description of access.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide all items of finish hardware required to adequately trim, hang, and operate all doors, as is hereinafter specified and listed in the Hardware Schedule.
 - 1. Provide hardware for doors and frames of unusual profile or shape or other special conditions.
 - 2. Provide all necessary standard and special fasteners, screws, bolts, expansion shields or anchors to properly secure hardware to its intended door, frame, or other surface.
- B. Related Sections include the following:
 - 1. Hollow Metal Doors and Frames: Section 08 11 13.
 - 2. Flush Wood Doors: Section 08 14 16.
- C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section:
 - 1. Permanent cores to be installed by Owner.

1.2 REFERENCES

- A. The following reference standards and model code documents shall be used in estimating and detailing door hardware, and shall be considered as a standard of quality, function, and performance, as applicable:
 - 1. I.B.C. 2000 Edition.
 - 2. NFPA-80 Fire Doors & Windows (current year adopted).
 - 3. NFPA-101 Life Safety Code (current year adopted).
 - 4. NFPA-105 Smoke Control Door Assembly (current year adopted).
 - 5. ANSI-117.1 1992 Edition Providing Accessibility and Usability for Physically Handicapped People.
 - 6. ADAAG Americans with Disabilities Act Accessibility Guidelines.

1.3 ACTION SUBMITTALS

- A. General: Submit the following in accordance with Section 01 33 00.
- B. Product Data: Provide a catalog cut sheet, clearly marked and identified, illustrating and describing each product included in the Hardware Schedule.
 - 1. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Formulate catalog cut sheets into sets and include a set with each copy of the Hardware Schedule submitted.

- C. Door Hardware Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Complete designations of every item required for each door or opening including name and manufacturer.
 - c. Fastenings and other pertinent information.
 - d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule. Use same scheduling sequence and format and use same door numbers and hardware set numbers as in the Contract Documents.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other Work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- D. Wiring Diagrams: For electrified hardware items specified for this Project, Provide complete wiring diagrams along with riser drawings and elevations, showing locations where such material is to be installed. Wiring Diagrams shall be submitted with Hardware Schedule. Verify and coordinate with the electrical systems installer. Integration shall take effect into central system as specified by Owner.
1. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
 2. Sequence of Operation: Include description of component functions that occur in the following situations:
 - a. authorized person wants to enter;
 - b. authorized person wants to exit;
 - c. unauthorized person wants to enter;
 - d. unauthorized person wants to exit.
- E. Samples for Verification: If so requested by the Architect, provide a sample of any product or item requested, properly marked and tagged, for the opening for which it is intended.

- F. Keying: Provide a keying schedule, listing the levels of keying, (GGMK, GKD, MKD or KA) as well as an explanation of the key system's function, the key symbols used and the numbers of the doors controlled. Provide in conjunction with the Door Index/Keying Schedule (which lists the door number, schedule heading, lock type and individual key symbol and remarks or special instructions) mentioned in above. Project shall be Masterkeyed and/or Grand Masterkeyed and provide two (2) keys per lockset or cylinder.

1.4 INFORMATIONAL SUBMITTALS

- A. Operation and Maintenance Data: For each type of door hardware to include in maintenance manuals. Provide latest, revised and updated schedule of finish hardware, complete with catalog cuts and keying schedule. In addition, furnish one (1) copy of maintenance and parts manuals for those items for which they are readily available and normally provided.
 - 1. Submit in accordance with provisions of Section 01 78 23.

1.5 QUALITY ASSURANCE

- A. Substitutions: Request for substitutions for alternative hardware items will not be accepted on this Project unless specifically indicated. Specification indicates one (1) specified product, listed hereinafter in the Hardware Schedule, and two (2) acceptable alternative manufacturers for that product. If any specified product is listed as a "No Substitution" product, only that specified product shall be provided as indicated.
- B. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 1. The hardware supplier shall be engaged regularly in the furnishing, delivery and servicing of contract builder's hardware and must be experienced and knowledgeable in all phases of estimating, detailing, scheduling, masterkeying, shipping and installation practices.
 - 2. When electro-mechanical or electronic hardware is supplied, a qualified individual with a minimum five- (5) year's experience shall be available for assistance.
- D. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant and 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.
- E. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- F. Regulatory Requirements: Comply with provisions of the following:

1. Provide hardware that complies with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)", and ANSI A117.1.
 - G. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - I. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination". Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 2. Preliminary key system schematic diagram.
 3. Requirements for key control system.
 4. Address for delivery of keys.
 5. Location of Key Cabinet.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Marking and Packaging: All items of hardware shall be delivered to the site in manufacturer's original cartons or boxes. Each item of hardware shall be marked with the abbreviation set forth on the Shop Drawings to ensure that the product reaches its installation destination without needing specific hardware product number knowledge.
 - B. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
 - C. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- 1.7 COORDINATION
- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
 - B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system, as applicable.

1.8 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: If there are any products listed hereinafter that normally require a maintenance or service contract, provide the Owner and Architect with details and costs of standard maintenance or service contract.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Hardware Schedule" Article.
- B. Product manufacturers listed with an asterisk (*) denote the specified manufacturers listed in the Hardware Schedule. The remaining two (2) listed manufacturers will be acceptable substitutions. If only one manufacturer is listed this shall be considered a "No Substitution" specification as set forth in "Quality Assurance" Article, for that particular item.

2.2 MATERIALS

- A. Screws and Fasteners: Provide all screws and fasteners of the proper size and type to properly anchor or attach the item of hardware scheduled. Provide all fasteners with Phillips heads, unless security type screws (spanner-head or torx-head) are hereinafter specified.
- B. Hinges: Provide as follows:
 - 1. On doors to exterior openings and main corridor doors, and other doors of high frequency use, provide a continuous, gear type hinge of appropriate weight.
 - 2. Where regular ball bearing hinges are listed for other doors, provide one hinge for each 30-inch of door height.
 - 3. The width of the hinges shall be sufficient to clear all trim that is mounted to the doorframe.
 - 4. Hinges shall be guaranteed for life of opening if installed per manufacturer's recommendations.
 - 5. Acceptable Manufacturers:
 - a. Hager*
 - b. Stanley.
 - c. McKinney.

- C. Continuous Hinges: Continuous hinges shall consist of three (3)-interlocking extrusions in a pinless assembly applied to the full height of the door. All continuous geared hinges shall be manufactured to template screw locations and be non-handed. All mortise hinges and half mortise hinges shall cover and wrap the door edge completely. Doorframe heads shall be extended for clearance on full or half mortise hinges versus downsizing doors for ease of repair and replacement. All frames shall be properly reinforced per manufacturer's standards.
1. Standard warranty shall be for the life of opening.
 2. Acceptable Manufacturers:
 - a. Pemko*
 - b. Select.
 - c. Roton.
- D. Locks: All locks shall incorporate a seven pin tumbler system and be keyed to a GRANDMASTER SYSTEM as not to breach security of system in place. Keying system must be guaranteed of no duplication of existing change keys, master keys or grandmaster keys located in this Project. All keying shall be coordinated with Owner. Locks shall be Grade 1 mortise and/or cylindrical as hereinafter listed in the Hardware Schedule.
1. Acceptable Manufacturers:
 - a. Best*
 - b. Sargent.
 - c. Schlage.
- E. Lock Trim: Cylindrical/mortise locks are to be furnished with lever handle trim, with levers having a return to within 1/2 inch of the door face, as is hereinafter listed in the Hardware Schedule.
- F. Electronic Cylindrical Lockset: Heavy-duty lever handled, Grade 1, cylindrical lockset for commercial, industrial and institutional applications. Lockset shall combine key-in-lever design with motorized, programmable, stand-alone electronics for high security access control, which require no external wiring. Entry shall be by keypad.
1. Acceptable Manufacturers:
 - a. Schlage/Locknetics*
- G. Flush Bolts: Manual flush bolts to have 12-inch rods for doors 7'-6". Doors over 7'-6" high shall have bolts with top rods of 18 inch or 24 inch to allow ease of access to bolt lever. Furnish dust proof strikes for all bottom bolts.
1. Acceptable Manufacturers:
 - a. Ives*
 - b. Trimco.
 - c. Hager.
- H. Push/Pull Latch: Push/Pull Latch shall be U.L. listed for use on fire doors and provide secure and silent latching action. Provide with ANSI 115.1 strike.
1. Acceptable Manufacturers:
 - a. Glynn Johnson*
 - b. Hager.
 - c. Sargent.
- I. PRO Exit Trim/Exit Device: Keypad entry trim shall be a stand-alone, battery operated exit trim that is UL listed and tested for use with specified exit device.

1. Acceptable Manufacturers:
 - a. Von Duprin*
 - b. No substitutions.
- J. Power Supply: Power supply shall integrate with selected switching for maintained switching with an emergency interface relay wired into the fire alarm system to insure fail secure application. Battery backup shall be included to produce backup power at full load during power failure.
 1. Acceptable Manufacturers:
 - a. Von Duprin*
- K. Exit Devices: Exit Devices shall be rim, mortise or vertical rod type as called for in the Hardware Schedule. Devices shall be of the touch-pad type as is hereinafter specified in the Hardware Schedule. Exit devices shall be constructed to allow cylinder to be removed and rekeyed without removing the device from the door either by removable core cylinders or construction of exit device. Exit devices shall be constructed to allow the conversion from one function to another simply within lock stile case and selecting proper outside trim as specified hereinafter in the Hardware Schedule. Devices shall be furnished with outside trim lever handles matching locks.
 1. Acceptable Manufacturers:
 - a. Von Duprin*
 - b. Sargent.
- L. Exit Device (EL): Electric latch retraction, exit devices shall provide remote unlocking ability. A control switch or wiring schematic as specified shall allow an "exit" only or latched door to push-pull operation by a continuous duty solenoid retracting the latch bolt.
 1. Acceptable Manufacturers:
 - a. Von Duprin*
 - b. No substitutions.
- M. Card Reader/Controller: Access credential reader shall be capable of reading keypad codes to insure flexibility of control and management.
 1. Acceptable Manufacturers:
 - a. Locknetics*
 - b. No substitutions.
- N. Door Closers: Door closers shall be of cast iron and rectangular design, furnished with a full cover. Provide complete with backcheck, delayed action and hold-open as indicated. Closers shall be mounted out of the line of sight wherever possible (i.e., room side of corridor doors, etc.) with parallel arm mounting on out-swinging doors. Mount closers to jamb or on brackets and/or drop plates, where special conditions require.
 1. Acceptable Manufacturers:
 - a. LCN*
 - b. Sargent.
- O. Push Plates: Push plates are to be .050 brass, bronze or stainless steel with four (4) beveled edges, drilled and countersunk for screws, as is hereinafter specified in the Hardware Schedule.
 1. Acceptable Manufacturers:
 - a. Ives*
 - b. Trimco.
 - c. Hager.

- P. Door Pulls: Door pulls shall be ADA compliant with a 2 1/2 inch projection from back of pull to face of door. All door pulls shall be thru-bolted or back-to-back mounted.
1. Acceptable Manufacturers:
 - a. Ives*
 - b. Trimco.
 - c. Hager.
- Q. Protective Plates: Protective plates shall be mop (6"), kick (10") or armor (34") and shall be minimum .050 thick brass, bronze, or stainless steel, with three (3) beveled edges, drilled and countersunk for screws. Plates shall be mounted to avoid louvers and/or glass kits.
1. Acceptable Manufacturers:
 - a. Ives*
 - b. Trimco.
 - c. Hager.
- R. Door Stops and Holders: Where a door strikes a wall at approximately 90 degrees, a suitable door stop shall be provided, either a wall bumper or floor stop. Where doors are undercut, provide floor stops with adequate height to properly stop the door. If door would not otherwise strike a wall, an overhead stop shall be provided. In-wall blocking for wall bumpers at stud walls shall be provided in accordance with Section 06 10 53. Provide reinforcing in frame and door for overhead stops.
1. Acceptable Manufacturers:
 - a. Ives*
 - b. Hager.
 - c. Glynn-Johnson.
- S. Thresholds and Weatherstrip: Weatherstripping to have aluminum housing, specified insert, and elongated mounting holes. Door sweeps shall be surface mounted, of aluminum/stainless steel housing with specified insert. Overhead drip caps to be of aluminum, have a 2 1/2-inch projection and be 4 inches wider than the door opening. Thresholds shall be of saddle type with no more than 1/2 inch rise. Weatherstripping and smoke seals shall be surface-mounted on doorstop and have 1/4" adjustment slots.
1. Acceptable Manufacturers:
 - a. Pemko*
 - b. Hager.
 - c. NGP.
- T. Wall Magnets: Magnets shall be fail safe and hold until the current is interrupted. Current input shall be factory selected to be 24V AC/DC or 120V AC and be protected against voltage surges up to 600 volts. If voltage less than 120 VAC is indicated, provide transformers as required to accommodate power supply on specified magnets. Maximum holding force shall be forty (40) pounds. Magnet covers shall be of metal composite. Plastic covers will not be accepted.
1. Acceptable Manufacturers:
 - a. LCN*
 - b. ABH.
 - c. Dorma.

- U. Push Button Switch: Push button switch assembly shall be a momentary action switch used as a redundant means of egress. Mount in single gang electrical box.
 - 1. Acceptable Manufacturers:
 - a. Locknetics*
- V. Electromagnetic Locks (Access Control): Electromagnetic lock shall have a 1500 lb. holding force containing a built in passive infrared (PIR) sensor to energize the magnetic lock when a person enters its field of view. Lock shall contain a built-in lighted emergency exit button as a redundant means of de-energizing lock. An access control system shall be integral to the lock with keypads/readers easily wired directly to the lock.
 - 1. Acceptable Manufacturers:
 - a. Locknetics*
- W. Power Supply: Designed and fabricated to interface with all designated electrical security components with no additional hardware. Power supplies shall be Underwriter Laboratories (UL) listed for general-purpose use tested to meet UL 1012 specifications. Power supplies shall have 12/24VDC field selectable output voltage. Output current shall be 1 Amp at 12VDC and 1 Amp at 24VDC. When required, interfacing to an emergency alarm system shall terminate power supply output. Power supply output voltage shall be filtered and regulated.
 - 1. Power supply shall be housed in a standard NEMA 1 enclosure with additional space for a minimum of four (4) 4 Amp/hour batteries providing battery back up when required. An integral battery charging circuit shall be standard. Provide key locking cover to prevent tampering.
 - 2. Basis of Design Product:
 - a. Locknetics Security Engineering Model 510*
- X. Select Entry System: Select Entry shall be electrostatically protected to 20KV. LED status indication for programming entry status and self-diagnostics. Operating temperature shall be -40 degree F to +150 degree F. Controller shall possess a nonvolatile memory and user codes shall be from three (3) to eight (8) digits long with selectable keypad or proximity. Other features shall include "timers" for relock and door prop time, adjustable 0-255 seconds.
 - 1. Acceptable Manufacturers:
 - a. Locknetics*
- Y. Intumescent Seal: Intumescent seal shall comply with door and frame manufacturers for positive pressure tests for fire and smoke. (UBC 7-2, Parts 1 & 2/UL10C).
 - 1. Acceptable Manufacturers:
 - a. Pemko*
 - b. Reese.
 - c. NGP.

2.3 FINISHES

- A. Hardware finishes shall match and be maintained to BHMA symbols, as indicated in the Hardware Schedule. Strict adherence to base metals and finish is required.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.4 KEYING

- A. Keying of locks and cylinders throughout project shall be scheduled through a key meeting with Architect, Owner, and hardware supplier. Key schedule shall be prepared and submitted to the Owner for approval. Copies of final key schedule with the bitting instructions shall be submitted as part of the Project Record Documents.

2.5 KEY CONTROL

- A. Provide key cabinet(s) of sufficient capacity to handle all keys, plus 50 percent expansion. Provide key control cross-reference chart and accountability (sign-out) tags.
 - 1. Acceptable Manufacturers:
 - a. Telkee*
 - b. Lund.
 - c. Key Control Systems.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- 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.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to SDI 107 or ANSI A250.6, whichever is more stringent.
- B. Wood Doors: Comply with DHI A115-W series.

3.3 INSTALLATION

- A. Installation shall be by a qualified installer with a minimum five (5) year's experience in the installation of commercial grade hardware. Manufacturer's instructions shall dictate templating and installation.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames".
 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors".
- C. 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 specified in Division 09 Sections. 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.
- D. Key Control System: Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.
- E. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect prior to installation.
- F. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- 3.4 FIELD QUALITY CONTROL
- A. Perform final inspection with hardware installer and hardware supplier present to ensure correct installation and operation, and check for any damaged or defective items. Observe and inspect that all hardware has been installed to its correct destination in proper working order.
 - B. Independent Architectural Hardware Consultant: Owner reserves the right to engage a qualified independent Architectural Hardware Consultant to perform a separate independent inspection and to prepare an inspection report.
- 3.5 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.
 1. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 3. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

- B. At completion of the installation and prior to Substantial Completion, make final adjustments to door closures and other items of hardware. Leave all hardware clean and fully operable. Should any item be found to be defective, it shall be repaired or replaced as directed.
- C. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 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 door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

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

3.8 MANUFACTURER'S ABBREVIATIONS

- A. Abbreviations that could be used within Door Hardware Schedule.
 - 1. MCK McKinney
 - 2. NO Norton
 - 3. PEM Pemko
 - 4. RF Rixson
 - 5. RO Rockwood
 - 6. SA Sargent

3.9 HARDWARE SCHEDULE

Hardware Sets

Set: 1.1 (Suite Entry Doors)

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	HINGE	TA2714 4-1/2" x 4-1/2"	652	MK
1	STOREROOM LOCK	63 64 8204 LNL	626	SA
1	SURFACE CLOSER	P7500 (par. arm)	689	NO
1	KICK PLATE	K1050 8" high 4BE CSK	630	RO
1	WALL STOP	400	626	RO
3	SILENCER	608		RO

Notes: Future card read opening.

Set: 2.0 (Passage Door)

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	HINGE	TA2714 4-1/2" x 4-1/2"	652	MK
1	PASSAGE SET	8215 LNL	626	SA
1	SURFACE CLOSER	P7500 (par. arm)	689	NO
1	WALL STOP	400	626	RO
1	KICK PLATE	K1050 8" high 4BE CSK	630	RO
3	SILENCER	608		RO

Set: 3.0 (Storage Rooms)

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	HINGE	TA2714 4-1/2" x 4-1/2"	652	MK
1	STOREROOM LOCK	63 64 8204 LNL	626	SA
1	WALL STOP	400	626	RO
3	SILENCER	608		RO

Set: 4.0 (Conference Rooms)

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	HINGE	TA2714 4-1/2" x 4-1/2"	652	MK
1	PASSAGE SET	8215 LNL	626	SA
1	WALL STOP	400	626	RO
3	SILENCER	608		RO

Set: 5.0 (Private Offices)

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	HINGE	TA2714 4-1/2" x 4-1/2"	652	MK
1	OFFICE LOCK	63 64 8205 LNL	626	SA
1	WALL STOP	400	626	RO
3	SILENCER	608		RO

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.1 SUMMARY

- A. Glass and glazing
- B. Related Sections:
 - 1. Rough carpentry: Section 06 10 00.
 - 2. Building thermal insulation Section 07 21 00.
 - 3. Joint Sealants: Section 07 92 00.
 - 4. Hollow steel doors and windows: Section 08 11 13.
 - 5. Flush wood doors: Section 08 14 16.
 - 6. Glazing Surface Films: Section 08 87 00.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design:
 - 1. Design exterior glazing, including comprehensive analysis, using performance requirements, design criteria and industry standards indicated herein.
 - 2. The glass manufacturer is responsible for the analysis and engineering of glass and glazing, as well as the fabrication and installation of the glass and glazing.
- B. General: Provide glazing systems capable of withstanding normal thermal movement, and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- C. Manufacturer's Engineering Analysis: For glass for exterior openings, the glass manufacturer is to perform wind load and thermal stress analyses and is to demonstrate compliance of glass with performance requirements.
- D. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: As indicated in the XXXXXXXX as prepared by XXXXX.
 - b. Impact Loads For Interior Installations: Per applicable code or herein referenced industry standard.
 - c. Window/Curtain Wall (Guardrails) Infill: Design glass in windows and curtain wall as a guardrail in glass areas below 42 inches above the finish floor. Design glass in these areas to resist a horizontal impact load of 200 pounds applied to any 1 square foot of infill area, at any point, in any direction on the glass infill.
 2. Maximum Lateral Deflection: For the following types of glass supported on four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
 - a. For monolithic glass lites heat treated to resist wind loads.
 - b. For insulating glass.
 - c. For laminated glass lites.
- E. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss and a temperature change (range) of 120 deg F ambient; 180 deg F, material surfaces.

1.3 ACTION SUBMITTALS

- A. Product data.
- B. Samples for Verification:
 1. 12 inch x 12 inch samples of each type glass.
 2. Color samples of glazing sealant selected.
 3. 12 inch x 12 inch samples of spandrel glass colors selected.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Literature: Materials description and installation instructions for glazing materials.
- B. Design Calculations: Provide design calculations showing conformance with the specified performance requirements prepared and certified by the glass manufacturer.

- C. Compatibility and Adhesion Test Report: Submit copies of statement from sealant manufacturer indicating that glass and glazing materials have been tested for compatibility and adhesion with glazing sealants and interpreting test results relative to material performance, including recommendations for primers and substrate preparation needed to obtain adhesion.
- D. Warranties: Signed copies of insulating glass units, coated and laminated glass and unframed mirror warranties.

1.5 QUALITY ASSURANCE

A. Comply with the following:

- 1. GANA Publications: GANA's - Glazing Manual.
- 2. Glazing Material: FS DD-G-451D and ASTM C 1036.
- 3. Glass Coating: ASTM C 1376 Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Glass.
- 4. Safety Glazing: ASTM C 1048, ASTM C 1172, ANSI Z97.1, U.S. Consumer Product Safety Commission Standard 16 CFR 1201 CI and CII, and GANA'S - Glazing Manual and Laminated Glass Design Guide.
- 5. Insulating Glass:
 - a. Manufacturing: ASTM E 2190, Class CBA.
 - b. Testing: ASTM E 2190.
 - c. Installation: SIGMA TM-3000, Vertical Glazing Guidelines, and SIGMA TB-3001, Sloped Glazing Guidelines.

B. Unless otherwise shown or governed by other referenced standards specified, conform with details and procedures of GANA Glazing Manual, (National Glass Association).

C. Installer Qualifications: An experienced installer, as evidenced by a minimum of 5 consecutive years experience, and who has completed glazing similar in material, design, and extent to that indicated for project and whose work has resulted in construction with a record of successful in-service performance.

D. Source Limitations:

- 1. Insulating Glass: Obtain insulating glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.
- 2. Laminated Glass: Obtain laminated glass units from one manufacturer using the same type of glass lites and interlayers for each type of unit indicated.
- 3. Tempered Glass: Obtain tempered glass units from one manufacturer using the same type of glass and tempering process for units.

- E. In the event of a conflict between specified standards or references the more stringent or greater is to take precedent and be the one utilized for the design and installation.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver glazing materials to project site in manufacturer's unopened containers, fully identified with trade name, color, size, hardness, type, class and grade. Store each item in accordance with manufacturer's instructions. Immediately remove from the job site damaged or otherwise unsuitable material, when so ascertained.

1.7 WARRANTY

A. Insulating Glass Units:

1. Provide insulating glass unit manufacturer's written warranty for the insulating glass units to be free of visual obstruction due to internal moisture or dust collecting on the interior glass surfaces.
2. Provide warranty in accordance with the General Conditions, except the warranty period is to be for 10 years instead of 1 year.
3. Provide warranty signed by the subcontractor and Insulating Glass Manufacturer with copies submitted to the Architect.

- B. Laminated Glass: Provide a written 5 year warranty from date of manufacture for laminated glass. Warranty covers deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions.

- C. The above warranties are in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Clear Float Glass: Complying with ASTM C 1036, Type I, Class 1, Quality q3, thickness as shown or specified, tempered in doors and adjacent lights where shown on Drawings or required by codes.
- B. Clear Low-Emissivity (Low E) Glass: Complying with ASTM C 1376, thickness as shown or specified, tempered in doors and adjacent lights and heat strengthened where shown on Drawings or required by codes, one of the following:

1. "Solarban 70XL" (VITRO).
 2. "Energy Select 28" (AGC).
 3. "SNX62/27" (Guardian).
 4. "VNE1-63" (Viracon).
- C. Clear Laminated Glass: Complying with ASTM C 1172, two layers of tempered or heat strengthened clear glass laminated with 0.0350 inch thick clear polyvinyl butyral (PVB) interlayer, thickness as determined by the glass manufacturer to comply with the specified performance requirements, where shown on Drawings, provide interlayer by one of the following:
1. "Trosifol" (Kuraray America, Inc.).
 2. "Saflex" (Eastman Chemical Company).
- D. Glazing Tape: Polyisobutylene/Butyl, complying with ASTM C 1281:
1. Dap, Inc., Butyl Rubber Tape.
 2. Pecora Corporation, G-66 or BB-50.
 3. Tremco, Tremco 400 Tape.
- E. Setting Blocks: Neoprene blocks, 70 to 90 Type A durometer hardness.
- F. Spacers: Neoprene blocks, 40 to 50 Type A durometer hardness, 3 inches long, self-adhesive on one face only.

2.2 INSULATING GLASS

- A. Provide units manufactured, tested, and approved in accordance with SIGMA requirements. Provide units warranted for 10 years by the manufacturer against material obstruction of vision resulting from film formation or dust collection between glass surfaces.
- B. Insulating-Glass Units: Preassemble units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 2190 for Class CBA units and with requirements specified in this Article and in the Glazing Schedule.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article.
 2. Provide Kind FT (fully tempered) where safety glass is indicated or required by codes.

- C. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Glazing Schedule are nominal and the overall thickness of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
- D. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - 1. Manufacturer's standard black color sealants.
- E. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.3 HEAT TREATED TEMPERED AND HEAT STRENGTHENED GLASS

- A. Provide tempered and heat strengthened glass horizontally heat treated in accordance with FS DD-G-1430B. Fabricate tempered and heat strengthened glass units so that roll distortion lines are parallel to the bottom edge of the glass units and the bottom or sill of the glazing pocket into which the glass unit is being installed.
- B. Provide heat treated glass complying with ASTM C 1048 for the following:
 - 1. Kind HS: Heat strengthened.
 - 2. Kind FT: Fully tempered.

2.4 GLAZING SEALANTS

- A. Provide products of type indicated, complying with the following requirements:
 - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will 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. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.5 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.
- C. Grind smooth and polish exposed glass edges and corners.

2.6 GLAZING SCHEDULE

- A. TBD
- B. Glass Type GL-3 (Monolithic): Minimum 1/4 inch clear glass, fully tempered.

PART 3 EXECUTION

3.1 PREPARATION

- A. Examine surfaces to receive the parts of the work specified herein. Verify dimensions of in-place and subsequent construction. Application or installation of materials constitutes acceptance of the related construction.

3.2 INSTALLATION - GENERAL

- A. Employ only experienced glazers who have had previous experience with the materials and systems being applied. Use tools and equipment recommended by the glass manufacturer.
- B. Measure openings and cut glass accurately to fit each opening with minimum edge clearances and bite on glass as specified by GANA. If glass is to be cut to size at project site deliver each piece to project at least 2 inches larger (in both dimensions) than required, so as to facilitate the cutting of clean cut edges without necessity of seaming or nipping. Do not seam, nip or abrade tempered glass at the job site.

- C. Maintain a minimum temperature of 40 deg F during glazing unless the manufacturer of the glazing materials specifically agrees to application of his materials at lower temperatures. If job progress or other conditions require glazing work when temperatures are below 40 deg F (or below minimum temperature recommended by the manufacturer), consult the manufacturer and establish the minimum provisions required to ensure satisfactory work. Record in writing to the manufacturer, with copy to the Architect, the conditions under which such glazing work proceeds and the provisions made to ensure satisfactory work.
- D. Clean glazing stops and rabbets to receive glazing materials of obstructions and deleterious substances which might impair the work. Remove protective coatings which might fail in adhesion or interfere with bond of sealants. Comply with manufacturer's instructions for final wiping of surfaces immediately before application of primer and glazing sealants or tapes.
- E. Prime surfaces to receive glazing sealants in accordance with manufacturer's recommendations, using recommended primers. Test materials and surfaces for adhesion of sealants.
- F. Inspect each piece of glass immediately before installation. Do not install pieces which have significant impact damage at edges, scratches or abrasion of faces or any other evidence or damage.
- G. Locate setting blocks at the quarter points of sill but no closer than 6 inches to corners of glass. Use blocks of proper size to support the glass in accordance with manufacturer's recommendations.
- H. Provide spacers for glass to separate glass from stops, except where continuous gaskets or tape are required. Locate spacers 36 inches o.c. maximum inside and out, with a minimum of 2 spacers per edge of glass. Provide thickness equal to sealant or compound thickness shown. Provide width as required for minimum of 3/8 inch bite on glass at edges.
- I. Set glass in a manner which produces greatest possible degree of uniformity in appearance. Face glass, which has dissimilar faces, with matching faces in the same direction. Set glass with bow (if any) to exterior.
- J. Install tempered and heat strengthened glass units with the roll distortion parallel to the bottom or sill glazing pocket in accordance with the glass manufacturer's recommendations for the type of glass installation.
- K. Do not use glazing materials from different sources in the same joint system unless the manufacturer of each material has stated in writing that his material is fully compatible with the other material.

- L. Install glass flooring with frame clearances recommended by the glass flooring manufacturer.
- M. Use masking tape or other suitable protection to limit coverage of glazing materials to the surfaces intended for sealants.
- N. Glazing Tape:
 - 1. Butt or lap ends of sealant tape in accordance with the manufacturer's recommendations.
 - 2. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
 - 3. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
 - 4. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.
 - 5. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
 - 6. Do not remove release paper from tape until just before each glazing unit is installed.
- O. Clean excess sealant from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.

3.3 GASKET GLAZING (DRY)

- A. Install glass units in curtain walls, windows, doors, sidelites, interior glazing channels and metal framed skylights using curtain wall, glazing channel, window door or skylight manufacturer's standard extruded glazing gaskets and strips installed in accordance with manufacturer's printed installation instructions.
- 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. 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. Install gaskets so they protrude past face of glazing stops.

3.4 PROTECTION AND CLEANING

- A. Protect glass from breakage immediately upon installation. Use streamers or ribbons suitably attached to framing and held free of glass. Do not apply warning markings directly to the glass.
- B. Remove and replace glass which is broken, cracked, chipped or damaged in any way and from any source, including weather, vandalism and accidents during the construction period.
- C. Maintain glass in a reasonably clean condition during construction so that it will not become stained and will not contribute to the deterioration of glazing materials.
- D. Wash and polish glass on both faces just prior to final acceptance. Comply with instructions and recommendations of glass manufacturer and glazing materials manufacturer for cleaning in each case.

END OF SECTION

SECTION 08 87 00
GLAZING SURFACE FILMS

PART 1 GENERAL

1.1 SUMMARY

- A. Glazing surface films, including installation materials.
- B. Related Sections:
 - 1. Glazing: Section 08 80 00

1.2 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM E 84 - "Standard Test Method for Surface Burning Characteristics of Building Materials."
 - 2. ASTM E 903 - "Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres."
 - 3. ASTM D 3330 - "Standard Test Methods for Peel-Adhesion at 180 Degree Angle."

1.3 SUBMITTALS

- A. Product Data: For each film product indicated.
- B. Samples for Color Selection: Manufacturer's standard sample sets showing the full range of colors available for each type of product indicated.
- C. Samples for Verification: 12-inch square samples of each type of glazing film specified, in color specified.
- D. Warranty: Special warranty specified in this Section.
- E. Maintenance Data and Replacement Instructions: For each type of film overlay to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by film manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements.
- B. Source Limitations: Obtain each type of film overlay through one source from a single manufacturer to provide products of consistent quality in appearance and physical properties.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store and protect glazing films according to manufacturer's written instructions and as needed to prevent damage, condensation, temperature changes, direct exposure to sun, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with film installation when ambient and substrate temperature conditions are outside limits permitted by manufacturer and when glass substrates are wet from frost, condensation, or other causes.

1.7 WARRANTY

- A. Surface Film Manufacturer is to warrant in writing the specified glazing surface film to be free from faults and defects including fading, delamination, peeling, cracking, or blistering in accordance with the General Conditions, except the warranty is to be for five (5) years instead of one (1) year.
- B. Provide warranty covering both labor and material to replace glazing surface film which becomes defective in any of the categories listed above.
- C. Provide copies of warranty signed by the Glazing Surface Film Manufacturer and submit to the Architect.
- D. This warranty is in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

1.8 MOCK-UP INSTALLATION

- A. Apply glazing film to not less than 9 square feet of glass, in locations as directed by Architect to verify selections made under sample selections and to demonstrate aesthetic effects and qualities of materials and execution.
 - 1. Obtain approval of field samples before continuing with remainder of installation.
 - 2. Maintain field samples during remainder of installation in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approved field samples may become part of the completed Work.

PART 2 PRODUCTS

2.1 GLAZING SURFACE FILMS

- A. Film Overlay: Single-layered applied glazing film products, 2 mils minimum thickness, applied to interior glass surfaces, consisting of the following (from outboard surface to inboard surface), as applicable to each type of film indicated:
 - 1. Removable release liner.
 - 2. Pressure sensitive adhesive.
 - 3. Clear, dyed, etched or printed pattern layer of polyester film.
 - 4. Scratch resistant coating.
- B. Product and Colors: Provide product and colors as manufactured by one of the following:
 - 1. 3M Fasara
 - 2. Decorative Films, LLC
 - 3. LLumar iLLusions
 - 4. As indicated on the Drawings.

2.2 GLAZING FILM ACCESSORIES

- A. General: Provide products complying with requirements of glazing film manufacturer for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Adhesive: Pressure Sensitive acrylic adhesive system.
- C. Cleaners, Primers, and Sealers: Types recommended by glazing film manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine glass and surrounding adjacent surfaces for conditions affecting installation.
 - 1. Report conditions that may adversely affect installation. In report, include description of any glass that is broken, chipped, cracked, abraded, or damaged in any way.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Immediately before beginning installation of films, clean glass surfaces of substances that could impair glazing film's bond, including mold, mildew, oil, grease, dirt and other foreign materials.
- C. Blade the inside surface of window glass with industrial razors to ensure removal of foreign contaminants.
- D. Protect window frames and surrounding surfaces and materials from damage during installation.

3.3 INSTALLATION

- A. General: Comply with glazing film manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements are indicated.
- B. Install film continuously, but not necessarily in one continuous length. Install with no gaps or overlaps.
- C. If seamed, install with no gaps or overlaps. Install seams vertical and plumb. No horizontal seams allowed.
- D. Do not remove release liner from film until just before each piece of film is cut and ready for installation.
- E. Install film with mounting solution and custom cut to the glass with neat, square comers and edges to within 1/8 inch of the window frame.

- F. Remove air bubbles, wrinkles, blisters, and other defects.
- G. After installation, view film from a distance of 10 feet against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, banding, thin spots, blisters or pinholes.
 - 1. If installed film does not meet this criteria, remove and replace with new film.

3.4 CLEANING

- A. Remove excess mounting solution at finished seams, perimeter edges, and adjacent surfaces.
- B. After application of film, wash film using cleaning methods recommended by glazing film manufacturer. Do not use abrasive-type cleaning agents or bristle brushes.
- C. Replace films that cannot be cleaned.

END OF SECTION

SECTION 09 05 61.13

MOISTURE VAPOR EMISSION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

1.2 UNIT PRICES

- A. Work of this Section is affected by Moisture Vapor Emission Control Unit Price and will be applied under the following conditions:
 - 1. In the event that the results of pre-construction testing determine or reveal that relative humidity, vapor emission levels, or alkalinity-pH of concrete floor slabs fall within adhesive and finish flooring system manufacturer's recommended maximum levels, Owner may elect to omit system.

1.3 DEFINITIONS

- A. MVE: Moisture vapor emission.
- B. MVER: Moisture vapor emission rate.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product.
- B. Informational Submittals:
 - 1. Qualification Data: For Installer and manufacturer.
 - 2. Product Test Reports: For each MVE-control system, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - 3. Preinstallation testing reports.
 - 4. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
 - 1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F (18 deg C) and not more than 85 deg F (29.4 deg C) at least 48 hours before use.
 - 2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29.4 deg C) and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F (3 deg C) higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

1.8 WARRANTY

- A. Warranty: Manufacturer to warrant control system products and components to maintain adhesion to all types of concrete substrates, concrete silicates and treatments, tolerant to moisture, alkalinity-pH and relative humidity during a 15 year period. Warranty includes repair and replacement of flooring products, coatings, primers and finishes applied over the control system surface and labor costs in the event of system failure during warranty period.
1. Warranty shall commence from Date of Substantial Completion.
- B. Warranty shall not exclude foreign salts, admixtures, resin and silicate surface treatments or surface due to normal concrete movement. Installation deems acceptance of on-site conditions.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
1. MVER: Maximum 15 lb of water/1000 sq. ft. (6.80 kg of water/92.9 sq. m) when tested according to ASTM F1869.
 2. Relative Humidity: Maximum 100 percent when tested according to ASTM F2170 using in situ probes.
- B. Water-Vapor Transmission: Through MVE-control system, maximum 0.10 perm (5.75 ng/Pa x s x sq. m) when tested according to ASTM E96/E96M.
- C. Tensile Bond Strength: For MVE-control system, greater than 200 psi (1.38 MPa) with failure in the concrete according to ASTM D7234.

2.2 MVE-CONTROL SYSTEM

- A. Manufacturers:
1. Ardex Engineered Cements
 - a. Product: Ardex MC Rapid.
 2. Koster American Corp.
 - a. Product: VAP I 2000.
 3. Sika Corporation
 - a. Product: Sika MB.

4. Stauf USA, LLC.
 - a. Product: ERP-270 Perma-Seal.
 5. Substitutions: None accepted.
- B. MVE-Control System: ASTM F3010 qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
 2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

2.3 ACCESSORIES

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi (20.68-MPa) compressive strength after 28 days when tested according to ASTM C109/C109M.
- B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.
- C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's hydraulic cement-based underlayment.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Preinstallation Testing:

1. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
 2. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.
 3. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. (9.29-sq. m) area of MVE-control system to prepared concrete substrate and test according to ASTM D7234.
 - a. Proceed with installation only where tensile bond strength is greater than 200 psi (1.38 MPa) with failure in the concrete.
- B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
 2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
 4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
 5. Fill surface depressions and irregularities with patching and leveling material.
 6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
 7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
 8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

- C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.3 INSTALLATION

- A. Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
 - 1. Install primers as required to comply with manufacturer's written instructions.
- B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.
- C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.
- D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.
- E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.
- F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform installation inspections.
- B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
 - 1. Verify that surface preparation meets requirements.
 - 2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
 - 3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.

- C. MVE-control system will be considered defective if it does not pass inspections.

3.5 PROTECTION

- A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.
- B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. Non-structural metal framing, including the following:

1. Non-load bearing interior light gauge steel studs and furring.
2. Ceiling and soffit suspension systems for interior gypsum board assemblies.
3. Backing plates not provided by other trades for support of items attached to metal framing system.
4. Supplementary parts and components, such as clips, fasteners, supplementary framing, and other miscellaneous accessories required for a complete installation.

B. Related Sections:

1. Rough carpentry: Section 06 10 00.
2. Building thermal insulation: Section 07 21 00.
3. Penetration firestopping: Section 07 84 13.
4. Gypsum board: Section 09 29 00.

1.2 SYSTEM DESCRIPTION

A. Delegated Design Requirements:

1. Drawings of metal support system assemblies are diagrammatic and show design intent of finished profiles, shapes and forms; relationships between elements; location, identification, dimension and size of components, assemblies and accessories; and details and diagrams of connections.
2. Unless otherwise indicated on the Drawings, engineer, fabricate, assemble, and install metal support systems to meet or exceed the criteria indicated; to conform to the profiles indicated; to satisfy applicable governing codes and regulations; and to provide structurally sound assemblies.

B. Performance Requirements: Unless otherwise indicated on the Drawings, engineer assemblies to withstand the loads prescribed by the authorities having jurisdiction, within the specified deflection limits.

1. Lateral loading: 5 psf for interior partitions; as prescribed for exterior walls.
2. Limit metal framing systems deflection under load to the following:

- a. L/240 where supporting gypsum board only.
- b. L/360 where supporting tile.

1.3 ACTION SUBMITTALS

- A. Product Data: Include a list of proposed products and materials to be provided for complete assemblies, along with manufacturer's product data, specifications, typical installation details and other data for each material listed to prove compliance with the specified requirements.
- B. Shop Drawings: large scale, dimensioned shop drawings for Contractor-engineered assemblies.
 1. Show framing member size, thicknesses, number, type, location, and spacing.
 2. Indicate component details, framing layout, framed openings, anchorage to structure, bracing, type and location of fasteners and welds, and accessories required for related work.
 3. Show metal thicknesses, spacing of members and span dimensions.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Design Data: When not indicated on the Drawings submit complete load and deflection tables properly annotated for the indicated framing sizes, spacing, span limits and thicknesses to be used.
- B. Certificates:
 1. Mill certificates and galvanizing certificates: Signed by framing member/accessory manufacturer certifying compliance with material requirements.
- C. Manufacturer's Installation Instructions: Submit manufacturer-prepared instructions concerning the proper preparation and installation framing members and framing accessories.

1.5 QUALITY ASSURANCE

- A. Installer's Qualifications: Firm and individuals with a minimum of 3 consecutive years experience in the installation of specified products on projects similar in material, design, complexity and extent to this Project, and whose work has resulted in applications with a record of successful in-service performance.

- B. Regulatory Requirements: Where fire-resistive construction is indicated, provide materials, accessories, and application procedures listed by UL, or tested according to ASTM E 119 for the type of construction shown, and approved by the authorities having jurisdiction.

1.6 HANDLING

- A. Delivery: Protect materials from excessive moisture in shipment, storage, and handling.
- B. Storage: Store off ground, either in a dry, ventilated, enclosed space or protected with suitable waterproof coverings.
- C. Handling: Protect metal framing units from rusting and damage.

1.7 SEQUENCING

- A. Coordinate placement of concealed internal wall reinforcement, such as backing plates, blocking, etc. for items to be attached to metal support systems.
- B. Coordinate installation of ceiling and soffit suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorage to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.
- C. Furnish concrete inserts, door frames, and other devices indicated, to other trades for installation well in advance of time needed for coordination with other construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide metal framing members from one of the following:
 - 1. MarinoWARE.
 - 2. SCAFCO Corporation.
 - 3. Clarkwestern Dietrich Building Systems LLC.
 - 4. Telling Industries.
 - 5. MBA Metal Framing.

2.2 STUDS, RUNNERS AND FURRING

- 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: ASTM A 653, G40.
- B. Smooth Steel Studs: ASTM C 645, punched web complying with the following:
1. Protective coating: ASTM A 653, G40 galvanized coating.
 2. Bracing: Where the wall finish does not adequately brace both flanges of studs, provide bracing or reduce allowable stresses for computing stud heights in compliance with requirements of the authorities having jurisdiction.
 3. Uncoated Metal Thickness: Minimum 0.018 inch, refer to the Drawings.
- C. Dimpled Steel Studs and Runners:
1. Protective coating: ASTM A 653, G40 galvanized coating.
 2. Bracing: Where the wall finish does not adequately brace both flanges of studs, provide bracing or reduce allowable stresses for computing stud heights in compliance with requirements of the authorities having jurisdiction.
 3. Uncoated Metal Thickness: Minimum 0.015 inch.
- D. Top and Bottom Tracks: As recommended by the manufacturer of each stud type and of the same thicknesses as the studs in same wall or partition, unless otherwise indicated on the Drawings. Provide unpunched, screwable tracks with 1-1/4-inch flanges.
- E. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Slip-Type Head Joints: To accommodate slab deflection where studs extend to the underside of beams, floor or roof slabs, secure at top with a deep leg, minimum 0.063 inch slip connection.
- F. Furring Channels: Minimum 0.018 inch thick, galvanized, hat-shaped.
- G. Horizontal stiffener, runner channels and bridging: Complying with ASTM A 1003, minimum 0.053 inch metal thick, channels fabricated of cold-rolled steel with flanges not less than 7/16-inch wide. Minimum weights as follows:

Channel Size	Flange Width	Pounds/1000 linear foot
3/4-inch	7/16-inch	300

1-1/2-inch	7/16-inch	475
2-inch	19/32-inch	590

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, minimum 0.062 inch diameter wire, or double strand of minimum 0.048 inch diameter wire.
- B. Wire: ASTM A 641, Class 1 zinc coating, soft temper:
 - 1. Hanger Wire: Minimum 0.12 inch diameter, unless otherwise indicated.
 - 2. Diagonal Bracing Wire: 0.08 inch diameter, unless otherwise indicated.
 - 3. Tie wire: 0.05 inch diameter, single-strand annealed steel or 0.04 inch diameter, galvanized, double-strand annealed steel.
- C. Metal Channels Supporting Suspended Ceilings (Carrying Channels): Provide metal channels complying with ASTM C 641, galvanized in compliance with ASTM A 924, G60 coating designation, for framing, furring and stiffening, as follows:

Size	Type	Pounds per 1,000 linear feet
3/4 inch	Cold-rolled	300
1 inch	Hot-rolled	410
1-1/2 inches	Hot-rolled	475
2 inches	Cold-rolled	590

- D. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2 inch wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: minimum 0.033 inch.
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: Minimum 0.033 inch thickness>.
- E. Direct Hung Suspension System (Alternate Method):
 - 1. Cross Tees: 1-1/2 inch high double web .020 inch thick electro-galvanized steel with 15/16 inch wide capped flange face.
 - 2. Wall Track: 1-1/2 inch to 1-5/8 inch inside dimensions .020 inch thick electro-galvanized steel with 15/16 inch to 1 inch wide top and bottom flange faces.
 - 3. Acceptable Products:
 - a. "Drywall Suspension System" (USG Corp.).

- b. "System 640" (Rockwool International).
 - c. "Drywall Grid System" (Armstrong World Industries, Inc.).
- F. 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.

2.4 FASTENERS AND ACCESSORIES

- A. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates; length and thickness required by Code, or recommended by the metal framing manufacturer when not prescribed by Code.
- B. Shot pins: 0.140-inch diameter low velocity powder-actuated drive pins equivalent to Ramset/Red Head No. 1508, or other as approved by Architect, with 7/8-inch minimum penetration into concrete.
- C. Anchor bolts: ASTM A 307, non-headed type.
- D. Expansion shields: FS FF-S-325, except do not use lead, fiber and plastic shields.
- E. For low walls: stud reinforcement "Floor Anchor" (Pinguist Tool & Die Co., Inc.), at every stud.
- F. Isolation Strip at Exterior Walls - Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine adjacent construction and supports.
- B. Correct conditions detrimental to the proper and timely completion of this work before proceeding with installation.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 WALL INSTALLATION

- A. General:
 - 1. Erect metal framing systems in compliance with their manufacturer's recommendations, the reference standards, the Drawings and these Specifications.
 - 2. Use minimum 0.039 inch thick studs at the following locations:
 - a. Each side of door openings.
 - b. Where studs support backing plates, plumbing fixtures and wall-supported cabinets.
 - 3. Do not attach metal framing to ducts, conduits or pipes. Do not allow metal framing and suspension wires to contact pipes.
 - 4. Cut framing components squarely for a tight fit against abutting members. Erect framing plumb and level to provide solid backing for finish materials. Install steel studs in a wall/partition so that their flanges point in the same direction.
 - 5. Do not exceed a 1/8-inch in 10-foot deviation (non-cumulative) from true lines and levels, nor 1/4-inch from true position. Perform necessary remedial work on framing to achieve specified tolerances.
- B. Wall/Partition Framing:

1. Layout partitions and permanently mark on slabs.
2. Align and securely anchor ceiling and floor tracks to building construction. Space anchors within 6 inches of ends of each track segment and at 24 inches o.c. maximum. Do not drive fasteners closer than 2 inches to slab or curb edge.
3. 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.
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.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Frame openings in stud walls. Provide double studs, closer spacing, and additional reinforcement as detailed or required at doorframes, interior windows and recesses for equipment.
7. Frame both sides of control joints in gypsum board surfaces with separate studs and a discontinuous runner; do not bridge the joint with system components or accessories.
8. Assemble corners using a minimum of 3 studs.
9. Install studs in single length, without joints, extending from floor to underside of floor or roof structure above, except where indicated on the Drawings to stop at or above suspended ceilings. Splicing studs is not permitted without the Architect's approval.
10. Where studs stop at or above suspended ceilings, unless otherwise indicated, brace every fourth stud (maximum) with opposite stud bracing at 45 deg angles securely anchored to the floor or roof above.
11. Attaching studs to runner: Attach studs to tracks by friction fit for single stud gypsum board partitions.
12. Attach the following studs to runner tracks with screws or with a crimping tool in compliance with the stud manufacturer's instructions, except where indicated to be welded.
 - a. Studs with gypsum board on only one side.
 - b. Studs on each side of doors.
 - c. Studs supporting wall hung plumbing fixtures.
 - d. Studs supporting wall hung urinal screens, toilet compartments, cabinets and equipment.
 - e. Attach corner studs, partition intersections, studs on each side of doorjamb, and other openings in walls/partitions as specified above.
13. Unless otherwise indicated, provide horizontal stiffeners consisting of 3/4-inch channels spaced at not more than 54 inches o.c. maximum in partitions/walls supporting wall supported cabinets. Attach stiffeners to each stud.

- a. Provide an additional 3/4-inch channel 6 inches above door head and extend 2 stud spaces beyond jamb studs.
 - b. Install channels in longest possible lengths, lap 12 inches and wire-tie at joints. Do not tie channels on opposite sides of staggered and double stud partitions together.
14. Double studs (face to face to form a tube) at locations adjacent to doors and openings. Extend studs at door openings to slab or deck above and anchor securely to bottom track (as specified in subparagraph 12.b. above) and to top slab or deck with clip angles.
- a. Locate additional studs not more than 2 inches from door and window frames, abutting partitions, partition corners, and other construction.
 - b. Install a section of track over door and window frames with a clip angle at each end and attach securely to the adjacent vertical studs.
 - c. Install cut-to-length studs at the location of vertical joints and at standard spacing over the doorframe header extending to the ceiling track.
15. Install studs 2 inches away from abutting concrete, steel columns or other structural elements. Extend the horizontal stiffeners and attach it to the structural element.
16. Provide additional framing, as required, for attachment of electrical boxes, fire extinguisher cabinets and similar items located in stud walls.
- C. Furring:
1. Provide furring attached to concrete and metal framing to conceal utilities, furred soffits, and other furring as indicated.
 2. Furring to receive gypsum board shall be screw-on channels directly attached to backing material, or applied over runner channels as applicable.
 3. Furring to receive plaster shall be 3/4-inch cold-rolled channels wire tied to 1-1/2-inch runner channels.
 4. Space furring as indicated for studs.
- D. Install extra stud, furring members and angle runners at terminations of gypsum board work, and at openings and where required for support of other work occurring in the gypsum board work.
1. Install sheet metal strapping, studs, hat-shaped channels or stud runners in walls where shown on the Drawings or as required by the conditions of the installation, minimum same thickness as stud framing, for the support and attachment of other work. Attach to stud framing with not less than three screws per stud.

3.4 INSTALLING CEILING & SOFFIT SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- 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. Do not attach wires to, or bend around, interfering material such as ductwork, pipes and conduits
 - 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. Do not attach hangers to steel roof deck.
 - 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

- F. Space main runners not over 4 feet O.C. in any dimension so that hanger wires do not support more than 12 square foot of ceiling.
- G. Hang suspended framing independent of walls, columns, pipes, ducts, and conduits, and their insulation.
- H. Space runner channels not more than 6 inches from parallel walls or beams.
 - 1. Align runner channels accurately relative to indicated ceiling height and saddle-tie with hanger wires.
 - 2. Lap channels 12 inches at splices and tie at each end of lap.
- I. Attach furring channels to runner channels at right angles to carrying channels with clips or with 0.05 inch diameter tie wire with triple wrap and triple twist.
 - 1. Space at not over 12 inches O.C. for lath/plaster assemblies, and 16 inches O.C. for gypsum board.
 - 2. Locate approximately 2 inches from parallel walls.
 - 3. Lap channels 12 inches at splices and wire-tie at each end of lap.
 - 4. Assemble and install metal grillage so that it is rigid, square, and free of movement, and level within the tolerances specified.
 - 5. At control joints, provide discontinuous lap in main runners occurring over joints.
 - a. Do not bridge joints with cross furring where joints run perpendicular to furring.
 - b. Where joints run parallel to furring, provide furring to support each side of joint.
- J. Provide recesses and openings where indicated for lighting fixtures, registers, access panels and other items to be installed in ceilings. Provide additional furring channels where required by opening condition.
- K. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

- A. Gypsum board, including the following:
 - 1. Interior gypsum board.
 - 2. Tile backer board.
 - 3. Gypsum sheathing board.
 - 4. Installation accessories and finishing materials.

- B. Related Sections:
 - 1. Rough carpentry: Section 06 10 00.
 - 2. Building thermal insulation: Section 07 21 00.
 - 3. Penetration firestopping systems: Section 07 84 13.
 - 4. Joint firestopping: Section 07 84 43.
 - 5. Joint sealants: Section 07 92 00.
 - 6. Non-load bearing metal framing: Section 09 22 16.
 - 7. Hollow metal doors and frames: Section 08 11 13.
 - 8. Painting: Section 09 91 00.

1.2 ACTION SUBMITTALS

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

- B. Samples:
 - 1. 12 inch long samples of corner bead, end bead, reglets, moldings and control joint trim.
 - 2. Sample of electrical box pad.

1.3 QUALITY ASSURANCE

- A. Provide gypsum board construction complying with laws, ordinances, rules, regulations and orders of public authorities having jurisdiction over this part of the Work.

- B. Provide primary materials from a single manufacturer unless otherwise approved, in writing by the Architect, to insure total unit responsibility.
- C. Gypsum Board:
 - 1. Provide installation of gypsum board materials and systems construction complying with ASTM C 840, the manufacturer's current printed instructions and specifications and Gypsum Association, Standard GA 216 - Recommended Specifications for the Application and Finishing of Gypsum Wall Board, and Standard GA 600 - Fire Resistance Design Manual, current editions, except as herein modified and as approved by the manufacturer.
 - 2. In the event of a conflict between these specifications and the referenced standards, the more stringent or greater is to be utilized for the installation.
- D. Fire Resistive Construction:
 - 1. 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.
 - 2. Where gypsum board systems are indicated to have fire resistance ratings, including those required to comply with governing regulations, provide materials and installations identical with applicable assemblies which have been tested and listed by recognized authorities, including UL.
 - 3. Deflection and Firestop Track: Provide top runner in fire resistance rated assemblies indicated as labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Sound Transmission Characteristics: Provide materials and construction identical to those tested in the assembly indicated in accordance with ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
 - 1. Provide assemblies designed and pretested to achieve the minimum ratings as indicated on the Drawings.
- F. Comply with the seismic requirements of the local codes, ordinances, and regulations.

1.4 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other damage. Stack panels flat to prevent sagging.

1.5 PROJECT 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 interior products until installation areas are enclosed and environmentally 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

2.1 ACCEPTABLE GYPSUM BOARD MANUFACTURERS

- A. Georgia-Pacific Corp.; Portland, OR 97204.
- B. Continental Building Products Inc., Herndon, VA 20170.
- C. National Gypsum Company, Charlotte, NC 28211.
- D. United States Gypsum Co.; Chicago, IL 60680.
- E. Certainteed Corporation, Valley Forge, PA 19482.

2.2 GENERAL - PANELS

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

2.3 GYPSUM PANELS

- A. Gypsum Board: Complying with ASTM C 1396, regular, Type X or Type C, tapered with beveled or radial edge for finished joints, thickness as shown on the Drawings.
- B. Gypsum Ceiling Board: Complying with ASTM C 1396, tapered with beveled or radial edge for finished joints, 1/2 inch thickness, regular and Type X (fire-rated).

- C. Exterior Gypsum Soffit Board: Complying with ASTM C 1396, tapered edge for finished joints, thickness as shown on the Drawings, regular and Type X (fire-rated).
- D. Gypsum Sheathing Board: Unless noted on the Drawings, or specified otherwise, provide one of the following at the Contractor's option:
 - 1. Glass-Mat Faced Gypsum Exterior Sheathing Board: Complying with ASTM C 1177 and ASTM D 3273, regular, 1/2 inch thick, (Type X, 5/8 inch thick where required to be fire-rated), provide one of the following:
 - a. "Dens-Glass Gold Exterior Sheathing and Dens-Glass Gold Exterior Fireguard Sheathing" (Georgia-Pacific).
 - b. "Glasroc Sheathing" (CertainTeed).
 - c. "EXP Sheathing and EXP Fire-Shield Sheathing" (National Gypsum).
 - 2. Paperless (No Facing) Gypsum Sheathing Board: Sheathing Board: Complying with ASTM C 1177, ASTM C 1396 and ASTM D 3273, regular, 1/2 inch thick, (Type X, 5/8 inch thick where required to be fire-rated), "Aqua Tough Fiberrock Exterior Sheathing" (USG) or other as approved by Architect.

2.4 TILE BACKER BOARD

- A. Provide at shower walls, bath tub bulkheads, wet walls and other walls indicated on the Drawings. Unless noted on the Drawings, or specified otherwise, provide one of the following at the Contractor's option:
 - 1. Cementitious Board: Fiberglass mesh reinforced portland cement aggregate water resistant mixture formed boards, 1/2 inch thick, complying with ASTM C 1325 and ANSI A118.9, one of the following:
 - a. "Durock" (USG, Chicago, IL 60680).
 - b. "Wonder-Board" (Custom Building Products, Seal Beach, CA 90740).
 - c. "Util-A-Crete" (Fin Pan, Inc., Hamilton, OH 45012).
 - d. "Perma Base" (National Gypsum).
 - 2. Glass Mat Faced Water Resistant Gypsum Tile Backer Board Complying with ASTM C 1178 and ASTM D 3273, regular, 1/2 inch thick, (Type X, 5/8 inch thick where required to be fire-rated, provide one of the following:
 - a. "Dens-Shield Tile Backer" (Georgia-Pacific).
 - b. "GlasRoc DiamondBack Tile Backer" (CertainTeed).
 - c. "e²XP® Tile Backer" (National Gypsum).

2.5 TRIM ACCESSORIES

- A. Interior Trim: Comply with ASTM C 1047.

1. Material: Paper faced galvanized steel sheet or rigid PVC.
 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Control (expansion) joint.
 - d. Tear-Away Bead: L-Shaped, exposed long flange receives joint compound.
 3. Reveal Molding: Extruded aluminum alloy 6063 T5, with (mill) clear anodized finish, AAC12C22A21, standard lengths, "Type WDM-50-75" (Fry Reglet) or other approved by Architect. Width of reveal as shown on the Drawings.
- B. Foam Gaskets: Closed cell vinyl foam adhesive backed strips that allow fastener penetration without foam displacement, thickness as indicated on the Drawings, in width to suit metal stud size indicated on the Drawings.
- C. Control Joints: Roll formed zinc or extruded vinyl as standard with the board manufacturer.
- D. Preformed Cyclorama Panels
1. Material: Preformed High-Impact ABS Plastic Modules
 - a. Shapes
 - 1) Radiused floor cove modules
 - 2) non-parabolic corner module
 - 3) vertical corner modules
 2. Basis of Design: Super 2.5-EZ, Pro Cyc Inc, Clackamas, OR 97015

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
- 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 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 drying type, all-purpose compound.
 - a. Use setting type compound for installing paper faced metal trim accessories.
 3. Fill Coat: For second coat, use drying type, all-purpose compound.
 4. Finish Coat: For third, coat, use drying type, all-purpose compound.

D. Sheathing Joint and Penetration Treatment Materials:

1. Sealant for Glass Mat Gypsum Sheathing Board: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing, and recommended by tape and sheathing manufacturer for use with fiberglass sheathing tape and for covering exposed fasteners.
2. Sheathing Tape for Glass Mat Sheathing Board: Self-adhering fiberglass tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturer for use with silicone emulsion sealant in sealing joints and penetrations in glass mat gypsum and paper faced sheathing board and with a history of successful in-service use.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- D. Screws:
 1. Metal Studs: Type S and S-12 bugle head and pan head, sized to suit thickness, zinc plated for exterior use, complying with ASTM C 1002 and ASTM C 954.
 2. Wood Studs: Type W, 1-1/4 inch long or Type S bugle head and pan head, sized to suit thickness, zinc plated for exterior use, complying with ASTM C 1002 and ASTM C 954.
 3. Gypsum: Type G, sized to suit thickness, zinc plated for exterior use, complying with ASTM C 1002 and ASTM C 954.
 4. Gypsum Sheathing: Provide size, type, material and finish as recommended by gypsum sheathing manufacturer for substrates indicated.
 5. Provide fasteners with a hot-dip zinc coating complying with ASTM A 153.
 6. Fastening to Metal Studs: Use 1-1/2 inches long, galvanized screws.
- E. 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.

- F. Acoustical Sealant: As specified in Section 07 92 00 – Joint Sealants
- G. Electrical Box Pads: Moldable Polybutene pads, minimum 1/8 inch thick, , provide on the following:
 - 1. "Lowery's Electrical Box Pads" (Harry A. Lowery & Associates, Inc., Sun Valley, CA 91352).
 - 2. "3M Putty Pads" (3M Fire Protection Products, St. Paul, MN 55144).
 - 3. "Series SSP" (Specified Technologies Inc., Sommerville, NJ 08876).
- H. Spot Grout: Joint treatment compound as recommended by the manufacturer for spot grouting hollow metal door and window frame anchors, complying with ASTM C 475.
- I. Surfacers: "Sheetrock Brand Tuff-Hide" (USG).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, 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.

3.2 PREPARATION

- A. When the outside temperature is below 55 deg F, provide heat and maintain in areas where the work is to be performed. Provide heat continuously and uniformly at 55 deg F from one week prior to start of installation until gypsum board application and joint treatment is completed. Do not start installation until windows are glazed and doors installed or openings temporarily closed. Provide ventilation to remove excess moisture during joint treatment.
- B. Coordination with Sprayed Fire Resistive Materials: After sprayed fire resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire resistive material thickness below that which is required to obtain fire resistance

3.3 INSTALLATION - 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 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 backing 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, including 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. Spot-Grouting: At hollow metal door and window frames spot-grout each jamb anchor, filling the inside face of the jamb at each anchor.

- 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. Separate by 24 inches horizontally outlet boxes and other penetrations on opposite sides of the partition in separate stud cavities and treat with outlet box pads.
- K. Install sound attenuation blankets, where shown on the Drawings, pressure fit between studs. Fill voids. Openings and gaps, butt joints of blankets and support and secure in accordance with manufacturer's recommendation when not self-supporting.

3.4 APPLYING INTERIOR GYPSUM BOARD

A. 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. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

- 1. 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.
- 2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.5 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. Control Joints: Install controls joints in accordance with the following:
 - 1. Install control joints according to ASTM C 840.
 - 2. In specific locations as drawn for visual effect.
 - 3. Where a partition, wall, or ceiling traverses a construction joint (expansion, seismic, or building control element) in the base building structure.
 - 4. Where a wall or partition runs in an uninterrupted straight plane exceeding 30 lineal feet.
 - 5. Interior Ceilings with Perimeter Relief: Install control joints so that linear dimensions between control joints does not exceed 50 ft and total area between control joints does not exceed 2,500 sq. ft. Install a control joint or intermediate blocking where ceiling framing members change direction.
 - 6. Interior Ceilings without Perimeter Relief: Install control joints so that linear dimensions between control joints does not exceed 30 ft and total area between control joints does not exceed 900 sq. ft. install a control joint or intermediate blocking where ceiling framing members change direction.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. Tear-Away Bead: Use at exposed panel edges.
- D. Apply gypsum board screws with an electric driver. Drive screws not less than 3/8 inch from edges or ends of panels to provide a uniform dimple not over 1/32 inch deep.
- E. Cyclorama: Install preformed cyclorama modules in accordance with the following:
 - 1. Follow manufacturer's instructions for installation and finishing of modules
 - 2. Clean and prep all surfaces prior to installation.
 - 3. Prepare preformed modules for installation before assembly by sanding and cleaning each module with damp cloth.
 - 4. Install plywood where preformed modules meet the wall, horizontally and vertically for attachment of modules.
 - 5. Regularly remove debris and dust from modules to assure clean surface and tight fit.

6. Use fiberglass mesh tape on joints between preformed modules and the wall/floor, do not use this tape at joints between modules.
7. Allow joint compound to completely dry prior to applying additional coats.
8. Use a minimum of three coats of joint compound, sanding and cleaning after each coat, to achieve the desired, seamless finish.
9. Prime and paint with manufacturer's recommended primer and paint as required for the substrate. Color, finish and sheen to match on walls, preformed panels and floor of cyclorama.

3.6 INSTALLATION OF TILE BACKER BOARD

- A. Install tile backer board on walls to receive ceramic and/or stone tile; on plumbing fixture wet walls, in toilet areas, shower areas, baths, showers and bath tub surrounds and other wet area walls shown on the Drawings. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- B. Support ends of boards over framing. Fasten boards to studs with 1-1/4 inch long screws spaced 16 inches o.c. and at perimeter 8 inches o.c. not less than 3/8 inch nor more than 5/8 inch for board edges.
- C. Prefill joints with latex-portland cement mortar, then embed backer board manufacturer's or manufacturer approved tape and level the joints.
- D. Install water resistant gypsum board of the same thickness above tile backer board on walls with ceramic tile wainscot and full height on other walls in toilet rooms and wet areas.

3.7 INSTALLATION OF EXTERIOR GYPSUM SHEATHING

- A. Comply with GA-253 and with manufacturer's written instructions.
- B. General: Fasten exterior gypsum sheathing to stud framing for exterior walls. Space fasteners as recommended by gypsum sheathing manufacturer. Keep perimeter fasteners 3/8 inch from edges and ends of board units. Fit boards tightly against each other and around openings.
- C. Install sheathing vertically with long edges parallel to and centered over studs. Provide solid framing wherever end joints do not bear against framing sills or plates. Fasten to each support in accordance with manufacturer's recommended spacing, but not more than the following:
 1. Space fasteners not more than 4 inches o.c. around perimeter at edge and end supports.

2. Space 8 inches o.c. at intermediate supports.

D. Seal sheathing joints and penetrations in accordance with the sheathing manufacturer's written instructions.

3.8 INSTALLATION OF ELECTRICAL BOX PADS

A. Install acoustical electrical box pads over electrical and other type of device boxes in sound rated walls, including but necessarily limited to electrical junction boxes, electrical switch boxes, power outlet receptacle boxes, thermostat control boxes, telephone outlet boxes and television cable or antenna outlet boxes.

B. Install in accordance with the printed installation instructions of the manufacturer.

C. Brush or wipe dust and dirt from box surface. If surface is contaminated with oil or other material that would impair pad application, wipe with Xylene or Toloulene to remove.

D. Center pad on back of box and mold around conduit or cable entering box. Mold pad around sides covering openings.

3.9 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 and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for 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.

3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

4. Level 5: At Cyclorama, areas as indicated on drawings

3.10 CLEANING AND PROTECTION

- A. Take precautions to minimize spattering of joint treatment compounds and other materials on other work. Remove joint treatment compounds promptly from doors, frames, glass and other finishes and surfaces that could be stained or marred by these materials. Clean floors of gypsum board materials and treatment compounds upon completion of the gypsum board work. At completion of work, remove unused materials, scraps, containers and equipment. Remove dust accumulated during finishing operations, leave areas broom clean, ready for painting, wall covering, ceramic tile or other finishes.
- B. Provide temporary protection of finish surfaces in areas of high traffic and susceptible to damage from work of others. Maintain protection throughout the construction period so that the work will be without damage or deterioration at the time of Substantial Completion. Repair or replace any damaged work. Remove temporary protection at completion of work or when required for completion of other work.
- 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.

3.11 SCHEDULE OF LOCATIONS

- A. Install gypsum board in the following locations:
 - 1. Gypsum Board: Vertical and horizontal surfaces, unless otherwise indicated.
 - 2. Gypsum Board Type X & C: Where required for fire resistance rated assembly.
 - 3. Gypsum Board Type X: Interior face of cold formed metal framing exterior walls.
 - 4. Abuse Resistant Gypsum Board: Where indicated on the Drawings.
 - 5. Gypsum Ceiling Board: Ceilings unless noted otherwise.
 - 6. Exterior Gypsum Soffit Board: Exterior soffits.
 - 7. Gypsum Sheathing Board: Where indicated on the Drawings.
 - 8. Tile Backer Board: Substrate for tile.
 - 9. Water Resistant Gypsum Board: Toilet, bath, and wet area walls, not covered by tile.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 GENERAL

1.1 SUMMARY

- A. Ceramic tile on walls and floors including, mortar grout, adhesives, underlayment, crack isolation membrane, and installation accessories and materials.
- B. Related Sections:
 - 1. Joint Sealants: Section 07 92 00.
 - 2. Gypsum board: Section 09 29 00.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces. Include details of movement joints.
- B. Samples:
 - 1. Samples: One of each type and finish of tile through range of color, with grouted joints.
 - 2. Sample of each tile trim shape.
 - 3. Samples of colored grout through full range of colors.
 - 4. 6 inch long samples of metal transition strips.
 - 5. 6 inch x 6 inch samples of crack isolation membrane on suitable backing material.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer`s Literature: Materials description and recommended installation instructions for manufactured mortar, grout, latex additive, grout sealer, crack isolation membrane.
- B. Certification: Copies of waterproofing membrane manufacturer's certification that the crack isolation and/or waterproofing membrane materials are compatible with the setting materials to be used in the installation.

1.4 QUALITY ASSURANCE

- A. Provide material and installation complying with following:
 - 1. Tile Council of North America Inc. (TCNA):
 - a. Handbook for Ceramic, Glass, and Stone Tile Installation.
 - 2. American National Standards Institute Specifications for:
 - a. Glazed Wall Tile, Ceramic Mosaic Tile, Quarry Tile and Paver Tile Installed with Portland Cement Mortar, A108.1:
 - 1) Ceramic Mosaic Tile Installed with Dry-Set Portland Cement Mortar, or Latex-Portland Cement Mortar, A108.5.
 - 2) Dry-Set Portland Cement Mortar, A118.1.
 - 3) Modified Dry-Set Cement Mortar, A118.4.
 - 4) Crack Isolation Membrane: A118.12.
 - 5) Grout, A118.6.
 - 6) Recommended Standard Specifications for Ceramic Tile, A137.1.
- B. Installer Qualifications: Engage an experienced installer with not less than 5 consecutive years experience and who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- C. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.
- D. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, and grout component from a single manufacturer and each aggregate from one source or producer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Accept delivery of material only in an undamaged condition; store above ground and in a dry place within the building. Maintain packaged material in original containers with seals unbroken and labels intact until time of use. Provide wrapped or bundled material bearing the name of the manufacturer and the product. Immediately remove from the job site damaged or otherwise unsuitable material, when so ascertained.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Tile Setting Materials:

1. Laticrete International, Inc.; Bethany, CT 06525.
2. Mapei Corporation, Elk Grove Village, IL 60007.
3. Bostik, Inc., Wauwatosa, WI 53226.

2.2 MATERIALS

- A. Floor and Wall Tile: Tile types, sizes, colors, patterns, products and manufacturers are indicated on the Drawings. Furnish trim shapes as required by conditions; angles, corners, bullnose, and other shapes required by installation conditions.
- B. Transition Strips: Extruded aluminum or galvanized steel "L" strips with zinc alloy exposed top edge, profile indicated. Acceptable Manufacturers:
1. Terrazzo Marble & Supply, Chicago, IL 60636.
 2. Tesco Products, Inc., Valencia, CA 91355.
 3. Schluter-Systems L.P., Plattsburgh, NY 12901.
- C. Perimeter Isolation: Flexible polyethylene foam perimeter isolation material used for isolating underlayment and finish floor at perimeter walls, provide one of the following:
1. "Quiet Qurl Perimeter Isolation" (Keene Building Products, Mayfield Heights, OH 44124).
 2. "Enkasonic Perimeter ISO" (Colbond, Inc., Enka, NC 28728).
- D. Latex-Portland Cement Mortar for Thin-Set or Tile Bond Coat for Bed-Set (Public Toilet Rooms): Prepackaged dry-mortar mix combined with liquid-latex additive. Provide one of the following:
1. "Laticrete No. 211" (Laticrete).
 2. "Kerabond" (Mapei).
 3. "Tile-Mate Floor & Wall" (Bostik Hydroment).
- E. Latex-Portland Cement Mortar for Thin-Set of Large Format Floor and Wall Tile: Prepackaged dry-mortar mix combined with water additive. Provide one of the following:
1. "Laticrete Sure Set" (Laticrete).

2. "Ultraflex LFT" (Mapei).
 3. "StoneWall" (Bostik Hydroment).
- F. Floor and Wall Grout (Colored): Un-sanded, for joints less than 1/8 inch wide.
1. "1600 Series Unsanded Grout" (Laticrete).
 2. "Keracolor U" (Mapei).
 3. "Dry Tile Grout, Unsanded" (Bostik Hydroment).
- G. Floor and Wall Grout (Colored): Sanded for joints 1/8 inch wide and greater.
1. "1500 Series, Sanded" (Laticrete).
 2. "Keracolor S, or Ultracolor Plus" (Mapei).
 3. "Ceramic Tile Grout, Sanded" (Bostik Hydroment).
- H. Latex Liquid Additive:
1. "Laticrete No. 4237 for mortar and No. 1776 for grout" (Laticrete).
 2. "Keralastic for mortar" (Mapei).
 3. "425 Multi-Purpose Acrylic Latex Admixture" (Bostik Hydroment).
- I. Crack Isolation Membrane (For thin-set floor tile): Factory prepackaged one part liquid rubber or two-part synthetic polymer and powder for trowel application with glass fiber fabric reinforcing compatible with setting materials:
1. "Blue 92" (Laticrete).
 2. "Mapelastc HPG" (Mapei).
 3. "Ultra-Set" (Bostik Hydroment).
- J. Grout Joint Sealer: Clear penetrating siliconized product compatible with the grout and tile materials used and approved by the grout and tile manufacturer. Provide sealer which is non-yellowing and will not change the appearance in texture or coloring of the grout and tile after application.

2.3 PROPORTIONING MORTAR AND GROUT

A. General:

1. When factory premixed grout is used in the installation with latex liquid additives, provide both products produced by the same manufacturer to ensure compatibility.
2. When factory premixed dry-set mortar is used in the installation with latex liquid additives, provide both products produced by the same manufacturer to ensure compatibility.
3. Crack Isolation Membrane: When used in the installation, provide a product produced by the same manufacturer as mortar to ensure compatibility.

4. The grout and mortar used in the installation may be from different manufacturers.
 5. Mix mortar and grout in accordance with the manufacturer's printed instructions.
- B. Floor and Wall Thin-Set Mortar: Factory premix with water or latex additive added in accordance with the manufacturer's recommendations.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
- B. 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. If present remove in accordance with the tile setting bed material manufacturer's requirements.
1. Comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 2. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed and/or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- C. Alkalinity and Adhesion Testing: Perform tests recommended by setting materials manufacturer. Proceed with installation only after substrates pass testing.
- D. Test for Moisture: Perform one or both of the following tests as required by the flooring material manufacturer to determine the manufacturer's acceptable floor slab moisture before installation.

1. Test floor slab for moisture by anhydrous calcium chloride method according to ASTM F 1869. Proceed with tile installation only after substrates have maximum moisture-vapor-emission rate recommended by the setting bed material and tile manufacturers. Proceed with installation only after substrates pass testing.
 2. Test floor slab for relative humidity by ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes. Proceed with installation only after substrates have maximum level humidity in the floor slab recommended by the setting bed material and tile manufacturers. Proceed with installation only after substrates pass testing.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Examine surfaces to receive the parts of the Work specified herein. Verify dimensions of in-place and subsequent construction. Verify that water resistant gypsum wallboard and tile backer board is installed and prepared in accordance with Gypsum Association GA 216-75. Application of materials constitutes acceptance of the substrate.
- B. Do not start work until grounds, anchors, plugs, hangers, bucks, etc. have been installed and until adjoining work is satisfactorily protected.
- C. Keep containers in which tile and other materials are packed dry until tiles and other materials are removed and every precaution taken to see that tiles are not stained before they are set in place. Maintain temperatures in rooms where tile is being set at a minimum of 40 deg F.
- D. Clean and mechanically etch floor and wall surfaces as required by conditions of the installation to maximize bond.
- E. Layout tile in each area as shown on the Drawings in such a manner as to minimize the cutting of tile.

3.3 TILE INSTALLATION – GENERAL

- A. 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.

- B. 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.
- C. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- 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. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. 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. Ceramic Mosaic Tile: 1/16 inch.
 - 2. Large Format Floor Tile: 1/8 inch.
 - 3. Glazed Wall Tile: 1/16 inch.
- F. Movement Joints:
 - 1. Construct movement (expansion & control) joints by installing wood strips extending through setting bed.
 - 2. Provide width of such joints as shown on the Drawings, but not less than 1/8 inch for ceramic mosaic and glazed tile and not less than 1/4 inch for quarry tile.
 - 3. If locations of such joints are not shown, install at restraining surfaces, such as walls, curbs, columns, pipes, over expansion joints in backing, at changes in backing material in accordance with TCNA Handbook EJ-171.
 - 4. In large interior tiled areas provide movement joints not more than 20 to 25 feet o.c. each way for slabs on grade and 8 to 12 feet o.c. for elevated slabs.
 - 5. After tile has set for three days, remove the wood strips, clean and repair the joints.
 - 6. Sealing of joints is included in Section 07 92 00.

3.4 INSTALLATION OF FLOOR TILE

- A. Dry-Set (Thin-Set) Mortar, TCNA Method F125A : For tile installed over crack isolation membrane:
1. Crack Isolation Membrane: Install crack isolation membrane and reinforcement fabric on cured above grade concrete slabs in accordance with the manufacturer's printed installation instructions. Allow the membrane to cure before proceeding with tile installation.
 2. Floor Tile:
 - a. Spread dry-set mortar on substrate in a minimum 3/32 inch thickness. Spread mortar with flat side of trowel and comb with serrated or notched side of trowel.
 - b. Place tile in position with a slight twisting motion using sufficient pressure to set tile firmly in mortar. Tap tile lightly to ensure maximum bond. Set tile before a skin forms on mortar.
 - c. Wipe tile clean with a soft damp cloth. Avoid excess use of water.

3.5 INSTALLATION OF WALL TILE

- A. Concrete Unit Masonry, TCNA Method W202, Gypsum Wallboard (Wet Areas), TCNA Method W243 and TCNA Method W244 Tile Backer Units, Dry-Set:
1. Tile on Tile Backer Board: Apply latex Portland-cement mortar, forcing it through the tape to completely fill and level the joints. Apply in several passes to accomplish level joints.
 2. Spread dry-set mortar on substrate in a minimum 3/32 inch thickness. Spread mortar with flat side of trowel and comb with serrated or notched side of trowel.
 3. Place tile base in position with a slight twisting motion using sufficient pressure to set tile firmly in mortar. Tap tile lightly to ensure maximum bond. Set tile before a skin forms on mortar.
 4. Keep joints straight and uniform in width not exceeding 1/16 inch, align with floor joints. Wipe tile clean with a soft damp cloth. Avoid excess use of water.

3.6 GROUTING

- A. After tile is firmly set, fill joints with appropriate Latex Dry-Set grout. Spread slurry of grout over the floor surfaces until joints are filled. On walls, after tile has set, remove string or rope spacers, if any, and force a maximum of grout into joints by trowel, squeegee, brush or finger application. Fill joints flush with surface of tile. Before grout sets, fill skips and gaps. Tool joints to cushion edge of tile. Remove surface laitance and excess grout with dry polishing cloths. Provide faces of tile, clean and free from grout or other stains.
- B. Cure floor grout by keeping damp for at least 72 hours. Add dampness as needed. Cover with polyethylene sheeting to facilitate curing.

3.7 INSTALLATION OF THRESHOLDS

- A. Aluminum Angle Thresholds: When shown on the Drawings, install aluminum angles at thresholds and transitions of ceramic floor tile. Set angles with aluminum or stainless steel flathead countersunk anchors of the type appropriate to the substrate, spaced not more than 6 inches on center and not more than 1-1/2 inches from the ends of angles.

3.8 CLEANING AND SEALING

- A. Upon completion of tile work in each area, including work specified under other Sections, clean tile surfaces with warm water and a high quality washing compound. Do not use acid or acid cleaners. Sponge and wash tile thoroughly, working diagonally across joints; polish with dry cloths.
- B. Immediately prior to occupancy by the Owner, wash tile surfaces, again, and perform additional grouting that may be necessary.
- C. After cleaning of tile and grout apply clear sealer to grout joints. Wipe tiles clean of sealer residue.

3.9 PROTECTION

- A. Cover tile floors with non-staining building paper or polyethylene sheeting until just prior to occupancy by the Owner. During construction protect tiled areas used as walkways with plywood boards in addition to other covering specified.

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Acoustical ceiling panels and suspension systems including, intermediate support framing when required by the conditions of the installation.
- B. Related Sections:
 - 1. Gypsum board: Section 09 29 00.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
 - 1. 12 inch square acoustical units for each type of unit.
 - 2. 1 foot-0 inch lengths of each suspension system components with manufacturer's standard color selections.
 - 3. 1 foot-0 inch lengths of edge trim system, with manufacturer's standard color selections.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- C. Coordination Drawings:
 - 1. Layout and details of acoustical ceilings.
 - 2. Show locations of items which are to be coordinated with, located in or supported by the ceilings.

1.4 QUALITY ASSURANCE

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
- C. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.
- D. Source Limitations for Ceiling Units and Suspension Systems: Obtain each acoustical ceiling panel and suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver unopened materials to the project site in manufacturer's unopened containers, clearly indicating manufacturer's name, brand, type, style, size, color, texture and other identifying information.
- B. Store materials in a dry location, off the ground and in a manner to prevent damage, deterioration and intrusion of foreign matter. Replace materials which have been damaged or are otherwise unsuitable. When ascertained, immediately remove damaged or otherwise unsuitable material from the project site.

1.6 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: Do not install acoustical ceilings until space has been enclosed and is weathertight, and until wet work in the space has been completed and is nominally dry, and until work above ceilings has been completed, and until ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

- B. Sequencing: Coordinate with the work of trades above the ceiling and penetrating or supported by it. Do not start work until appropriate work above the ceiling is complete.
- C. Coordination: Coordinate with electrical, HVAC and fire protection trades to ensure edge configuration of light fixture, air diffusers and sprinkler heads to penetrate or to lay in ceilings are proper for the system and provide system layout that accommodates lighting pattern.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Armstrong World Industries, Inc., Lancaster, PA 17603.
- B. CertainTeed Corporation, Valley Forge, PA 19482.
- C. Rockwool, LLC, Chicago, IL 60638.
- D. United States Gypsum, Chicago, IL 60606.

2.2 CEILING PANELS

- A. Acoustical Panels (24 inch x 24 inch, Lay-in): Mineral fiber acoustical panels; nominal 24 inch x 24 inch units not less than 3/4 inch thick, with beveled tegular edges, and factory applied washable white finish.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide products indicated on drawings or comparable products as approved by Architect.

2.3 CEILING SUSPENSION SYSTEM MATERIALS

- A. General: Comply with ASTM C 635 intermediate duty and heavy duty, as applicable to the type of suspension system required for the type of ceiling units indicated. Coordinate with other work supported by or penetrating through the ceiling, including light fixtures, HVAC equipment sprinklers and partition system.
- B. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, direct hung. Coordinate types of devices compatible with floor construction, verify with precast concrete plank manufacturer.

- C. Hanger Wires: Galvanized carbon steel, ASTM A 641, soft tempered, pre-stretched, yield stress load of at least three (3) times design load, but not less than 12 gage (0.016 inch).
- D. Edge Molding: Zinc coated steel or aluminum, configurations shown on the Drawings, or if not shown manufacturer's standard for system with baked enamel finish to match suspension systems.
- E. Exposed Grid Suspension Systems (24 inch x 48 inch, Lay-in): Direct hung, intermediate duty, double web, snap grid, exposed main runners, cross runners 9/16 inch wide and accessories, with exposed cross runners and wall trim coped to lay flush with main runners with factory applied baked enamel (white) finish, one of the following:
 - 1. Basis of Design Product: "Ultraline 4500 HRC 9/16 exposed with ¼" Reveal" (Chicago Metallic, Rockfon North America, Chicago, IL).
- F. Cold-Rolled Intermediate Support Channels: Minimum 1-1/2 inch, 475 lbs. per 1,000 lin. ft., complying with ASTM A 1008.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine surfaces to receive the parts of the Work specified herein. Verify dimensions of in-place and subsequent construction. Application or installation of materials constitutes acceptance of the supporting construction.

3.2 INSTALLATION OF MECHANICAL GRID SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C 636 and current AIMA recommended procedures.
- B. System Installation:
 - 1. Unless otherwise shown on the Drawings or required by the systems manufacturer's printed installation instructions, install hangers 4 ft. o.c. in rows 4 ft. apart.
 - 2. Do not attach hangers to steel roof deck. Attach hangers to structural members or intermediate support channels.
 - 3. Furnishing inserts and intermediate support framing and directing placement of inserts and framing is the responsibility of the acoustical ceilings installer.

4. Where supporting construction is steel, wrap the wire hanger around or through the steel member or attach by other secure methods.
 5. Wrap hanger around carrying channel, or if directly suspended, insert through hole in main tee and secure hanger with at least three (3) turns around itself.
 6. Intermediate Support Channels:
 - a. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, or where spacing of primary support does accommodate hangar spacing, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications
 - b. When required by the conditions of the installation, install intermediate support cold-rolled channels spaced not more than 4 feet-6 inches above direct hung ceiling grid system.
 - c. Grid Clips: Install ceiling manufacturer's standard grid clips attached to cold-rolled channels and direct hung ceiling grid system not more than 4 feet-0 inches o.c.
 7. Ceiling Grid: Install direct hung ceiling grid system to the ceiling panel model sizes shown on the Drawings and in accordance with the manufacturer's printed installation instructions.
- C. Coordinate spacing of hangers, carrying channels, runners, and molding with the location of ductwork, piping, conduit, electrical fixtures and other items occurring in or on ceilings.
- D. Provide additional hangers at corners of light fixtures at midpoint of cross tees adjacent to light fixtures and duct outlets and adjacent to main tee splices.

3.3 INSTALLATION OF PANELS

- A. Install acoustical panels in coordination with suspension system with edges concealed by support of suspension members and faces flush with grid webs. Arrange acoustical units and orient directionally patterned units in the configurations shown on the reflected ceiling plans and as directed by the Architect.
- B. Scribe or cut panels to fit accurately at penetrations.
- C. Use procedures that will minimize damage or soiling of the units during installation. Replace units which are damaged or cannot be adequately cleaned, as directed by the Architect at no additional cost to the Owner.

- D. Provide ceiling panel manufacturer's standard hold-down (retention) clips where shown or noted on the Drawings, or where required by conditions of the installation.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12, non-cumulative.

3.5 CLEANING AND PROTECTION

- A. Upon completion of the Work remove unused materials, debris, containers and equipment from the project site. Clean and repair floors, walls and other surfaces that have been stained, marred or otherwise damaged by work under this Section.
- B. Protect acoustical ceilings during the construction period so that they will be without any indication of deterioration or damage at the time of acceptance by Owner.

END OF SECTION

SECTION 09 65 13
RESILIENT WALL BASE

PART 1 GENERAL

1.1 SUMMARY

- A. Resilient wall base, including installation materials.
- B. Related Sections:
 - 1. Gypsum board: Section 09 29 00.
 - 2. Resilient tile flooring: Section 09 65 19.
 - 3. Carpet tile: Section 09 68 13.

1.2 ACTION SUBMITTALS

- A. Samples: Chain sets for color selection.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Literature: Materials description, installation and maintenance instructions.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer, with not less than 5 consecutive years experience, to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Receive materials in undamaged condition as packaged by the manufacturer with manufacturer's seals and labels intact.

- B. Store materials at the job site within the building and in a dry place at least 24 hours before installing flooring materials. Maintain space temperature not be less than 70 deg F nor more than 90 deg F.
- C. Immediately removed from the job site damaged or otherwise unsuitable material, when so ascertained.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Resilient Base:
 - 1. Rubber: Complying with ASTM F 1861, Type TS, Group 1 or 2, .080 gage, coved in resilient flooring areas and straight in carpeted areas, set-on type.
 - 2. Lengths: Coils in manufacturer's standard length.
 - 3. Base types, heights, colors, products and manufacturers are indicated on the Drawings.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Johnsonite.
 - c. Roppe Corporation, USA.
- B. Rubber Molding Accessories
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Johnsonite.
 - c. Roppe Corporation, USA.
- C. Adhesive: Water and alkali resistant, complying with recommendations of resilient flooring manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mix and apply adhesive as recommended by the manufacturer. Cover surface evenly. Do not exceed the maximum working area of the material. Install base within time limits recommended. If adhesive films over or dries, remove the adhesive and recoat the area.

- B. Firmly adhere resilient base to walls, columns, and permanent bases. Use longest lengths practical. Scribe bases accurately to abutting surfaces.
 - 1. Form internal and external corners and end stops with preformed units.
 - 2. Corners may be hand formed if method is approved by the Architect.
 - a. Form Outside Corners without producing discoloration (whitening) at bends.
 - b. Miter or cope corners to minimize open joints.
- C. Remove excessive adhesive in accordance with manufacturer's instructions.

3.2 CLEANING

- A. Not less than 4 days after flooring installation, clean base. Wash thoroughly, with a cleaner recommended by the manufacturer, in accordance with manufacturer's printed instructions.

END OF SECTION

SECTION 09 65 19.13

LUXURY VINYL FLOOR COVERING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid vinyl floor tile (luxury vinyl tile).

1.2 RELATED REQUIREMENTS

- A. Section 09 65 13 - Resilient Base and Accessories for wall base and accessories installed with flooring.

1.3 SUBMITTALS

A. Action Submittals:

- 1. Product Data: For each type of product specified.
- 2. Samples: Full-size tiles of each different color and pattern of resilient floor tile specified, showing the full range of variations expected in these characteristics.

B. Informational Submittals:

- 1. Test Reports: Pre-installation substrate moisture and alkalinity tests.
- 2. Qualification Data: For qualified Installer.

C. Closeout Submittals:

- 1. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 01.
- 2. Record Documents: Showing locations of substrate moisture and alkalinity tests. Provide markups on floor plan indicating the location of each test and the dates tests were performed.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

- B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Mockups: Install mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
 - 1. Locate mockup in location indicated or, if not indicated, in location as determined by Owner or Architect.
 - 2. Notify Owner and Architect seven days in advance of date and time when mockup will be installed.
 - 3. Demonstrate installation of vinyl tile flooring and related accessories.
 - 4. Obtain Architect's approval of mockups before starting work.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Remove unacceptable mockups when directed.
 - 7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 55 and 85 degrees F.
- C. Store tiles on flat surfaces.
- D. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install resilient vinyl tile flooring until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install products until they are at the same temperature as the space where they are to be installed.

- C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.
- D. Install tiles and accessories after other finishing operations, including painting, have been completed.
- E. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommendations, and field moisture and alkalinity tests.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.
 - 2. Deliver extra materials to Owner.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace resilient flooring that fail(s) in materials or workmanship within specified warranty period.
 - 1. Limited 10 year commercial.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Verify flooring products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 MANUFACTURERS

- A. Acceptable Manufacturers and Products: Refer to Finish Legend on Drawings.

2.3 SOLID VINYL FLOOR TILE (LUXURY VINYL FLOOR COVERING) - RT-1

- A. Tile Standard: ASTM F 1700.
1. Class: Class III, surface-decorated vinyl tile.
 2. Type: B, embossed surface.
 3. Thickness: Manufacturer's standard 0.096 inch (2.5 mm).
 4. Size: As indicated on Drawings.
 5. Profile: Beveled edge.
 6. Colors and Patterns: As indicated by manufacturer's designations.
 7. Basis of Design Product: Refer to Interior Finish Legend on Drawings.

2.4 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
1. Verify adhesives have a VOC content of 50 g/L or less.
 2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of tiles, and in maximum available lengths to minimize running joints. Refer to Interior Finish Legend on Drawings.
- D. Resilient base, floor finish transition strips, and accessories: Refer to Division 09 Section Resilient Base and Accessories.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 TILE INSTALLATION

- A. General: Comply with vinyl tile manufacturer's written installation instructions.
- B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.
 - 1. Lay tiles square with room axis, unless otherwise indicated.
- C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles in pattern of colors and sizes indicated on Drawings.
- D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- E. Extend tiles into toe spaces, door reveals, closets, 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 sub-floor. Use chalk or other nonpermanent, non-staining marking device.
- G. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- H. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Handroll tiles according to tile manufacturer's written instructions.

3.4 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing resilient products:

1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
2. Sweep or vacuum floor thoroughly.
3. Do not wash floor until after time period recommended by flooring manufacturer.
4. Damp-mop floor to remove marks and soil.

B. Protect flooring against mars, marks, indentations, and other 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 flooring manufacturer.

1. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.
2. Do not allow foot traffic or rolled traffic for time period after installation recommended in writing by flooring manufacturer, but not less than the following:
 - a. Foot traffic: Not less than 24 hours.
 - b. Rolled traffic: Not less than 72 hours.
3. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

END OF SECTION

SECTION 09 68 13

CARPET TILE

PART 1 GENERAL

1.1 SUMMARY

- A. Carpet tile as shown on the Drawings and specified herein, including edge strips, subfloor preparation and related materials of the carpet tile installation.
- B. Related Sections:
 - 1. Cementitious Floor Underlayment: Section 03 54 16.
 - 2. Moisture Vapor Emission Control: Section 09 05 61.
 - 3. Preinstallation Testing for Floor Finishes: Section 09 05 65.
 - 4. Resilient Wall Base: Section 09 65 13.

1.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient sheet flooring, 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- 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-size Sample.
 - 2. Edge Strips: 6 inch long pieces and samples of manufacturer's complete color range.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer`s Literature: Materials description and installation instructions for materials of the installation.
- B. Warranty: Signed copies of terms specified herein.
- C. Extra Material Receipt: Signed copies.

1.5 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.

1.6 EXTRA MATERIALS

- 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.
- B. Carpet Tile: Full-size units in boxes, equal to 5 percent of amount installed for each type or color indicated, but not less than 10 sq. yd.
- C. Submit a copy of the Owner`s representative signed itemized receipt for extra material required.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Carpet and Rug Institute's CRI 104.
- B. Deliver installation materials to project site in original factory containers, labeled with identification of manufacturer and brand name

- C. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Lay flat, blocked off ground. Maintain minimum temperature of 68 deg F at least three days prior to and during installation in area where materials are stored.

1.8 PROJECT/SITE CONDITIONS

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

1.9 WARRANTY

- A. General Warranty: Special warranty specified in this Article is not to deprive Owner of other rights Owner may have under other provisions of the Contract Documents and is in addition to, and is to run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Product Warranty: The carpet tile manufacturer is to provide a written warranty agreeing to replace defective carpet tiles in accordance with the General Conditions, except that warranty will be for 10 years, instead of 1 year. Provide written warranty signed by the Carpet Tile Manufacturer and the Installing Contractor and submit to the Architect.
 - 1. Defects include, but are not limited to:
 - a. More than 10 percent edge raveling, snags, runs.
 - b. Dimensional stability.
 - c. Excess static discharge.
 - d. Loss of tuft bind strength.
 - e. Loss of face fiber.
 - f. Delamination.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Carpet Tile (CPT-1, CPT-2, CPT-3): Carpet types, colors, patterns, products and manufacturers are indicated on the Floor Finish Schedule on the Drawings and Floor Finish Plans. Comparable products are subject to the Architect's approval and submission of substitution requests.
- B. Installation Adhesive: Water resistant and nonstaining, release adhesive as recommended by carpet tile manufacturer to comply with flammability requirements for installed carpet tile.
- C. Latex leveling compound: As recommended by the carpet tile manufacturer.
- D. Edge Strips: Solid vinyl of type shown on the Drawings, if not shown as selected by Architect from standard products and colors manufactured by one of the following:
 - 1. Burke Flooring, a Division of Burke Industries, Umatilla, FL 32784
 - 2. Johnsonite Solon, OH 44139
 - 3. Flexco Co., Tuscumbia, AL 35674
 - 4. Shaw Contract (Design Basis)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects. Application or installation of materials constitutes acceptance of substrate.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Verify that floor lab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. If present remove in accordance with the carpet and adhesive manufacturer's requirements.
 - 2. Subfloor finishes comply with requirements specified in Section 03 30 00 - Cast-in-Place Concrete, for slabs receiving carpet tile.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- D. Test for Moisture: Refer to Section 09 05 65 PREINSTALLATION TESTING FOR FLOOR FINISHES.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Level subfloors to be free of irregularities. Fill irregularities in the subfloor height affecting the carpet installation and appearance with troweled latex underlayment to create a ramp-like effect.
- C. Just prior to installation of carpeting and related materials, dry subfloors, broom clean, and remove oil, grease, paint or concrete treatment that may interfere with adhesion of carpet adhesive.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION - GENERAL

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Extend carpet tile under removable flanges and furnishings and into alcoves and closets of each space.
- C. Install carpet edge guard where edge of carpet tile is exposed; anchor guards to substrate.
- D. Install with pattern parallel to walls and borders. Install perimeter tiles as half-size or larger.
- E. Dry-fit sections of carpet tile prior to application of adhesive.
- F. Apply adhesive uniformly to substrate in accordance with manufacturer's instructions. Butt edges tight to form seams without gaps.

- G. Adhere perimeter tiles and partial tiles with a full spread of adhesive. Dry-fit cut tiles and apply adhesive to tile back after tile has been cut. In corridor areas, use full tiles down the center and cut perimeter tile borders.

3.4 CLEANING AND PROTECTION

- A. Remove adhesive from carpet tile surface with manufacturer's recommended cleaning agent.
- B. Vacuum using commercial machine with face-beater element. Remove soil. Replace carpet tiles where soil cannot be removed. Remove protruding face yarn.
- C. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
- D. Remove rubbish, wrapping paper and salvages from the job site. Leave excess pieces of usable carpet tile with the Owner.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation and the application of paint systems on interior substrates.

1.2 RELATED REQUIREMENTS

1.3 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: 5 to 10 units at 60 degrees and 10 to 25 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.

1.4 SUBMITTALS

A. Action Submittals:

- 1. Product Data: For each type of Paint System, submit product data cut sheets, including preparation requirements and application instructions.
 - a. Formulate product data cut sheets into sets for each Paint System required.
- 2. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - a. Step coats on Samples to show each coat required for system.

- b. Label each Sample with Paint System designation.
- c. Label each Sample for location and application area.
- d. Dry samples a minimum of 7-days before submitting.
- e. Submit Samples on the following substrates for the Architect's review of color and texture only:
 - 1) Gypsum Board / Plaster: Provide two 8-inches (200-mm) square samples on rigid backing.
3. Product List: For each product indicated, include the following:
 - a. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - b. VOC content.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (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

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products in the paint schedules.
- B. Manufacturers: The following manufacturers are referred to in the paint schedules by use of name or shortened versions of their names, which are shown in parentheses:
 - 1. Benjamin Moore (B-M).
 - 2. PPG Paints (PPG)
 - 3. Sherwin-Williams (S-W)

2.2 PAINT, GENERAL

- A. 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.
- B. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 50 g/L.
 - 3. Dry-Fog Coatings: 150 g/L.
 - 4. Primers, Sealers, and Undercoaters: 100 g/L.
 - 5. Rust-Preventive Coatings: 100 g/L.

6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
- C. Colors: Provide custom colors of the finished paint systems to match the Architect's samples.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that the 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.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" or "MPI Maintenance Repainting Manual" or more stringent instructions listed below applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair the 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.

3.3 APPLICATION

- A. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
 1. Painting includes identifying fire-rated wall assemblies with stenciled lettering above the ceiling. Provide stenciled block letters in red to identify each rated wall assembly. Refer to Section 09 29 00 - Gypsum Board.
 2. Stairs: Paint exposed surfaces including underside.
- B. Paint Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 1. Paint the following work where exposed in equipment rooms:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Plastic conduit.
 - f. Tanks that do not have factory-applied final finishes.
 - g. 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.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - 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. Unfinished and primed louvers and grilles, covers,
 - i. Exposed and insulated pipes.
 - j. Factory primed equipment.
 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork and casework.
 - b. Metal lockers.
 - c. Elevator entrance doors and frames.
 - d. Elevator equipment.
 - e. Finished mechanical and electrical equipment.
 - f. Light fixtures.
 - g. Panelboards and switch gear
 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas.
 - b. Ceiling plenums.
 - c. Utility tunnels.
 - d. Pipe spaces.
 - e. Duct shafts.
 - f. Elevator shafts.
 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper.
 - e. Bronze and brass.
- D. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable items, equipment, furniture, etc. the same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items, equipment, furniture, etc with prime coat only.
 3. Paint both sides and edges of doors and entire exposed surface of door frames.
 4. Paint the front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

7. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material required. Confirm use of spray equipment is acceptable to building owner in occupied areas.
- E. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- F. Tint undercoats same color as topcoat but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- G. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- H. 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.
- I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

3.4 FIELD QUALITY CONTROL

- A. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- B. 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.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing 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.

3.6 INTERIOR PAINT SCHEDULES

A. Gypsum Board (Gb) Substrates

- 1. Paint System Gb-L5: Latex, Semigloss Finish:
 - a. B-M:
 - 1) First Coat: Ultra Spec 500 Zero VOC Interior Zero VOC Latex Primer N534
 - 2) Second Coat: Ultra Spec 500 Zero VOC Interior Semi-Gloss 546
 - 3) Third Coat: Same as second.
 - b. PPG:
 - 1) First Coat: Speedhide Zero Interior Sealer, 6-4900XI.
 - 2) Second Coat: Speedhide Zero Interior Semi-Gloss, 6-5510
 - 3) Third Coat: Same as second.
 - c. S-W:
 - 1) First Coat: ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - 2) Second Coat: ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 Series.
 - 3) Third Coat: Same as second.
- 2. Paint System Gb-L2: Latex, Eggshell Finish:
 - a. B-M:
 - 1) First Coat: Ultra Spec 500 Zero VOC Interior Zero VOC Latex Primer N534
 - 2) Second Coat: Ultra Spec 500 Zero VOC Latex Eggshell N538
 - 3) Third Coat: Same as second.
 - b. PPG:
 - 1) First Coat: Speedhide Zero Interior Sealer, 6-4900XI.
 - 2) Second Coat: Speedhide Zero Interior Eggshell, 6-5310 Series.
 - 3) Third Coat: Same as second.

- c. S-W:
 - 1) First Coat: ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - 2) Second Coat: ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-2600 Series.
 - 3) Third Coat: Same as second.
- 3. Paint System Gb-L1: Latex, Flat Finish:
 - a. B-M:
 - 1) First Coat: Ultra Spec 500 Zero VOC Interior Zero VOC Latex Primer N534.
 - 2) Second Coat: Ultra Spec 500 Zero VOC Interior Latex Flat N536.
 - 3) Third Coat: Same as second.
 - b. PPG:
 - 1) First Coat: Speedhide Zero Interior Sealer, 6-4900XI.
 - 2) Second Coat: Speedhide Zero Interior Flat, 6-5110 Series.
 - 3) Third Coat: Same as second.
 - c. S-W:
 - 1) First Coat: ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - 2) Second Coat: ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series.
 - 3) Third Coat: Same as second.
- 4. Paint System Gb-X5: Waterborne Epoxy System, Semigloss Finish:
 - a. B-M:
 - 1) First Coat: Ultra Spec 500 Interior Zero VOC Latex Primer N534
 - 2) Second Coat: Corotech Pre-Catalyzed Waterborne Epoxy Semi-Gloss V341
 - 3) Third Coat: Same as second.
 - b. PPG:
 - 1) First Coat: Speedhide Zero Interior Sealer, 6-4900XI.
 - 2) Second Coat: Pitt-Glaze WB1 Pre-Catalyzed Acrylic Epoxy 16-510 Series.
 - 3) Third Coat: Same as second.
 - c. S-W:
 - 1) First Coat: ProMar 200 Zero VOC Interior Latex Primer, (a) B28W2600.
 - 2) Second Coat: Pre-Catalyzed Water Based Epoxy Semi-Gloss, K46-1150 Series.
 - 3) Third Coat: Same as second.
- B. Gypsum Board, Moisture-Resistant (Gm) Substrates:
 - 1. Paint System Gm-L5: Latex, Semigloss Finish:
 - a. B-M:
 - 1) First Coat: Insl-x High Build Latex Primer HB-2100
 - 2) Second Coat: Second Coat: Corotech Pre-Catalyzed Waterborne Epoxy (V341)
 - 3) Third Coat: Same as second
 - b. PPG:

- 1) First Coat: Speedhide Zero Interior Sealer, 6-4900XI.
- 2) Second Coat: Pitt-Glaze WB1 Pre-Catalyzed Acrylic Epoxy 16-510 Series.
- 3) Third Coat: Same as second.
- c. S-W:
 - 1) First Coat: ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - 2) Second Coat: Pro Industrial Pre-Catalyzed Waterbased Epoxy (a) Semi-Gloss, K46-1150 Series.
 - 3) Third Coat: Same as second.
2. Paint System Gm-L2: Latex, Eggshell Finish:
 - a. B-M:
 - 1) First Coat: Ultra Spec 500 Interior Zero VOC Latex Primer N534
 - 2) Second Coat: Corotech Pre-Catalyzed Waterborne Epoxy V342
 - 3) Third Coat: Same as second
 - b. PPG:
 - 1) First Coat: Speedhide Zero Interior Sealer, 6-4900XI.
 - 2) Second Coat: Pitt-Glaze WB1 Pre-Catalyzed Acrylic Epoxy 16-310 Series.
 - 3) Third Coat: Same as second.
 - c. S-W:
 - 1) First Coat: ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - 2) Second Coat: Pro Industrial Pre-Catalyzed Waterbased Epoxy (a) Eg-Shel, K45-1150 Series.
 - 3) Third Coat: Same as second.
3. Paint System Gm-X5: Waterborne Epoxy, Semigloss Finish:
 - a. B-M:
 - 1) First Coat: Ultra Spec 500 Interior Zero VOC Latex Primer N534
 - 2) Second Coat: Corotech Pre-Catalyzed Waterborne Epoxy V341
 - 3) Third Coat: Same as second
 - b. PPG:
 - 1) First Coat: Speedhide Zero Interior Sealer, 6-4900XI.
 - 2) Second Coat: Pitt-Glaze WB1 Pre-Catalyzed Acrylic Epoxy 16-510 Series.
 - 3) Third Coat: Same as second.
 - c. S-W:
 - 1) First Coat: ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - 2) Second Coat: Pre-Catalyzed Water Based Epoxy Semi-Gloss, K46-1150 Series.
 - 3) Third Coat: Same as second.

END OF SECTION

SECTION 10 14 23

PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Panel signs.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
 - 3. Division 23 Section "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
 - 4. Division 26 Section "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
 - 5. Division 26 Section "Interior Lighting" for illuminated Exit signs.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- C. Samples: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
 - 1. Aluminum: For each form, finish, and color, on 6-inch- (150-mm-) long sections of extrusions and squares of sheet at least 4 by 4 inches (100 by 100 mm).
 - 2. Acrylic Sheet: 8 by 10 inches (200 by 250 mm) for each color required.
 - 3. Polycarbonate Sheet: 8 by 10 inches (200 by 250 mm) for each color required.
 - 4. Panel Signs: Not less than 12 inches (305 mm) square including border.
 - 5. Accessories: Manufacturer's full-size unit.

- D. Sign Schedule: Use same designations indicated on Drawings or as indicated by Owner.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.
- B. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. 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.
- C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- D. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify recess openings and locations by field measurements/surveys before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which 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 metal and polymer finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image colors and sign lamination.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All interior signs, which require tactile copy and Grade II Braille shall be manufactured utilizing a 1/32", raised engraved lettering.
- B. The sign core shall be non-illuminated, 1/4" deep acrylic panel painted brushed aluminum finish with clear paper insert lens and colored accent. The expansion co-efficient of the core and laminate shall be matched to prevent warping and delamination. Match Owner Sample.
- C. Tactile lettering and logo shall be precision machined, raised 1/32", matte polycarbonate with painted finish to match Owner sample.
- D. Signs shall incorporate a metal message strip. Bars shall be brushed anodized aluminum 7/16" deep extrusion, length to match associated sign, containing grip rods to automatically grip any non-laminated paper inserted. Paper inserted from bottom and released by sliding left or right. Installed to wall using adhesive on back. Provide finished end caps matching extrusion.

2.2 PANEL SIGNS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:
 1. APCO Graphics, Inc.
 2. ASI-Modulex, Inc.
 3. Bunting Graphics, Inc.
 4. Innerface Sign Systems, Inc.
 5. InPro Corporation
 6. Olympik Signs.
 7. Takeform Architectural Graphics.

2.3 MANUFACTURED UNIT

- A. Sign Types: Shall include the following types of signage:
 1. Room I.D. with small insert
 2. Room I.D. with large insert.
 3. Conference Room
 4. Miscellaneous Room I.D.
 5. Safety Signage
 6. Directional Signs –directional signs at entry lobby.
- B. All signs are to be ADA compliant.
- C. Panel Sign Schedule: Refer Drawings for Schedule.

2.4 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.5 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 - 2. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 - 3. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.
- B. Fabrication of signage assemblies shall be in accordance with approved shop drawings and manufacturers' recommendations.
- C. All copies must be reproduced accurately and free from distortion. Round positive or negative corners, nicked or ragged edges are not acceptable. Arrows and symbols shall be reproduced exactly by photographic process and be submitted for approval prior to fabrication. The Sign Contractor is responsible for submitting and receiving approvals for any message layouts, which must be altered from specifications because of size constraints.
- D. The signage system shall utilize standard, interchangeable components that can be used singly or in combination.
- E. The signage system shall be capable of accepting paper or acetate inserts to allow changing and updating as required. Insert modules shall have a .080 thickness non-glare acrylic window and shall be inlaid flush to sign face for a smooth, seamless appearance.
- F. The signage system shall, with the exception of directories, back of house signs, and overheads, be a uniform 11 1/2" width to accommodate inserts printed on standard width paper.
- G. Manufacturer shall provide a Word template containing layout, font, color, artwork and trim lines to allow owner to produce inserts on a laser or ink jet printer.
- H. The signage system shall include modules allowing for inserts, notice holders, occupancy sliders, marker, magnetic, and cork pin boards. All modules shall be flush to sign face for a smooth, seamless appearance.
- I. The signage system shall utilize an acrylic sphere for Grade II Braille inserted directly into a mark and scratch resistant, high pressure laminate sign face. Braille dots are to be pressure fit in high tolerance milled holes. Braille dots shall be half hemispherical domed and protruding a minimum .025 high.

- J. Sign face shall be neoprene adhesive vulcanized to a composite core and precision machined together to a 90-degree angle. Edges shall be smooth, void of chips, burrs, sharp edges, marks and polished to a satin luster.
- K. The signage system shall incorporate a shim plate. The shim shall raise the sign off the wall allowing for cleaning and/or painting without removal.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 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.
- D. Finishes are to meet current Federal ADA and any State requirements.
- E. Copy shall be a true, clean, accurate reproduction of typeface(s) specified. Upper and lower case or all caps as indicated in Sign Type drawings and Signage Schedule. Letter spacing to be normal and interline spacing shall be set by manufacturer.
- F. Arrows, symbols and logo art: To be provided in style, sizes, colors and spacing as shown in drawings.
- G. Grade II Braille utilizing perfectly round, clear raster beads.
- H. Standard Colors
 - 1. Face/background color shall be standard grade, high pressure laminate, all colors and finishes.
 - 2. Standard tactile colors shall match manufacturer's ADA standard color selection.
 - 3. Core/backer color shall be (select dark brown or black) and polished to a satin luster.
- I. Primer coats or other surface pre-treatment where recommended shall be included.
- J. Sign colors shall match approved samples and shall be exactly as specified in unit descriptions. Sign colors shall be consistent in chroma and value, and shall maintain proper opacity or translucency and shall be free of all imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 - 2. Shim Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
 - 3. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
- C. Bracket-Mounted Signs: Provide manufacturer's standard brackets, fittings, and hardware for mounting signs that project at right angles from walls and ceilings. Attach brackets and fittings securely to walls and ceilings with concealed fasteners and anchoring devices to comply with manufacturer's written instructions.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION

SECTION 10 26 10
WALL AND CORNER GUARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Stainless steel corner guards, including mounting and installation accessories.
- B. Related Sections:
 - 1. Rough carpentry: Section 06 10 00.
 - 2. Non-load bearing metal framing: Section 09 22 16.
 - 3. Gypsum board: Section 09 29 00.

1.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", Illinois Accessibility Code, and ICC A117.1.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Plan layout of wall guards, details of each type of installation for wall and corner guards showing underlying and adjacent construction anchors, fasteners, their material and spacing.
- B. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples 6 inches square or 12 inches long as appropriate.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturers Literature: Materials description and installation instructions.
- B. Certification: Certified copies of U.L. test classification and fire rated wall test.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.
- B. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Furnish an amount equal to 2 percent of each type, color, and texture of cover installed, but no fewer than 2 units.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain wall and corner guards from one manufacturer.
- B. Provide wall and corner guards that have been tested and classified for a U.L. Class I rating.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver wall and corner guards in manufacturer's original unopened and undamaged packing. Clearly identify manufacturer, contents, stock number and order number on each package. Packages showing indications of damage that affect condition of contents are not acceptable. Do not deliver to project site until area of installation is ready for installation.
- B. Store in original packing under protective cover and protect from damage. Store containers in accordance with manufacturer's recommendations. Handle materials in such manner as to prevent damage to products or finishes.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nystrom, Inc., Minneapolis, MN 55428.
- B. Construction Specialties, Inc., Muncy, PA 17756.
- C. Korogard Wall Protection Systems; a division of RJF International Corporation, Fairlawn, OH 44333.
- D. Inpro Corporation, Muskego, WI 53150.

2.2 ITEMS

- A. General: Provide listed Basis of Design Products or comparable products, manufactured by an Acceptable Manufacturer, as approved by Architect.
- B. Surface Mounted Corner Guards: 90 degree, 14 GA, 304 stainless steel with No 4 satin finish surface mounted guards with 3 1/2 inch wide legs, bullnose corner. 48" length mounted with counter sunk stainless steel hardware aligned to the top of base, one of the following:
 - 1. "Model ACO-8, Acrovyn" (Construction Specialties).
 - 2. "3GSS35SD-CSH" (Nystrom).
 - 3. "GS10" (Korogard).
 - 4. "Stainless Steel" (Inpro).

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine surfaces and construction to receive parts of the work specified herein. Verify dimensions of in place and subsequent construction. Installation of wall and corner guards constitutes acceptance of the related construction and conditions.

3.2 INSTALLATION

- A. Coordinate the installation of wall and corner guards with the installation of required support and attachment framing to be located in walls.
- B. Install wall and corner guards in accordance with the manufacturer's printed instructions and the final reviewed shop drawings. Install guards straight and true to established lines.

3.3 CLEANING AND PROTECTION

- A. Remove and replace defective work or work that cannot be successfully repaired.
- B. Just prior to final acceptance, remove protective coverings and clean surfaces as recommended by the manufacturer.

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- C. Use procedures and precautions for protection of installed wall and corner guards until final completion of the Work.

END OF SECTION

SECTION 12 24 13
ROLLER WINDOW SHADES

PART 1 GENERAL

1.1 SUMMARY

- A. Manually operated roller window shades, including:
 - 1. Single rollers.
 - 2. Recessed overhead-mounting.
 - 3. Motorized Roller Shades
 - 4. Room Darkening Shadecloth (Single-Fabric) Shadecloth.
- B. Related Sections:
 - 1. Rough carpentry: Section 06 10 00.
 - 2. Non-structural metal framing: Section 09 22 16.
 - 3. Gypsum board: Section 09 29 00.
 - 4. Acoustical ceilings: Section 09 51 00.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Coordinate the electrical characteristics of electric devices and controls for the motorized roller shades.
 - 2. Provide power and panel boxes of sufficient size to accommodate roller window shade manufacturer's requirements, as indicated on the Drawings.
 - 3. Provide power and control conduit, junction boxes and wiring as required for roller window shade electrical wiring; coordinate requirements with roller window shade manufacturer and installer before inaccessible areas are constructed.

1.3 ACTION SUBMITTALS

- A. Product data sheets for window shades.
- B. Shop Drawings: Showing complete assembly and installation details, indicate supporting and adjacent building construction.
 - 1. Show and describe anchors and fasteners on the shop drawings.

2. Provide wiring diagrams
- C. Samples for Initial Selection: For each colored component of each type of shade indicated.
 1. Include similar samples of accessories involving color selection.
 2. Window manufacturer's standard color samples for exposed metal components showing the complete range of available standard colors.
- D. Samples for Verification:
 1. Shade Material: Not less than 12 inch square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Literature: including materials and fabrication descriptions and installation and operation instructions/specifications for window shades.
- B. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.
- C. Warranty: Copies of the warranty in the form and content (terms) indicated herein.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

1.6 QUALITY ASSURANCE

- A. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.
- B. Comply with laws, ordinances, rules, regulations and orders of public authorities having jurisdiction over this part of the work.
- C. Fire-Performance Characteristics: Provide shade material tested in accordance with NFPA 701 - Vertical-Burn Test and rated "PASS".

- D. Source Limitations: Obtain roller window shades through one source from a single manufacturer
- E. Installing Contractor: Roller Window Shade Manufacturer authorized (Certified) installation and service firm with a minimum of 5 consecutive years roller window shade installation experience. Provide written evidence of installation experience to Architect upon request.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver roller window shades in original unopened containers and packaging with manufacturer's name, brand name, U.L classification, installation instructions, and using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller window shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller window shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 WARRANTY

- A. The roller window shades manufacturer is to provide a written warranty stating that the roller window shades installation and associated controls will be free of faults and defects in accordance with the General Conditions, except that the warranty is to be extended by the Roller Window Shade Manufacturer for the following:
 - 1. Motor and Electrical Components: Provide warranty period of 10 years from date of Substantial Completion that installation is to remain operational without fault for the warranty period including coverage of motor, electrical controls, and override circuits.

2. Shadecloth: Provide warranty period of 10 years from Date of Substantial Completion that the shadecloth will not deteriorate, sag, or warp and will not be unfit for the use intended for the warranty period.
- B. Provide warranty signed by the Installing Contractor and the Window Shade Manufacturer and submit 3 copies to the Architect.
- C. This warranty is in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.
- B. Acceptable Manufacturers:
 1. MechoSystems, Inc, Long Island City, NY 11101
 2. Lutron Shading Solutions by Vimco, Ashland, VA 23228.
 3. Draper Inc., Spiceland, IN 47385.
 4. Hunter Douglas Contract, Poway CA.

2.2 BASIS-OF DESIGN

- A. Roller Window Shade System: products, materials and installation methods of Draper Inc., Spiceland, IN 47385.
- B. Environmentally Certified Room Darkening Shadecloth: fabricated from 50 percent polyester (base) and 50 percent foam (backing), meets Greenguard Gold, PVC free, opaque. Colors selected from manufacturer's available range.
 1. "Mermet Avila Twilight Canvas" Color: White, Backing: Match Face Color (Draper).

2.3 MATERIALS

- A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
1. System Type: Single motor and roller, gravity drop.
 2. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. Electric Motor: Manufacturer's standard tubular, enclosed in roller.
 - a. Maximum Total Shade Width: As required to operate roller shades indicated.
 - b. Maximum Shade Drop: As required to operate roller shades indicated.
 - c. Maximum Weight Capacity: As required to operate roller shades indicated.
 4. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for indicated mounting. Provide the following for remote-control activation of shades:
 - a. Individual/Group Control Station: Three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.
 - b. Color: As selected by Architect from manufacturer's full range.
 5. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
 6. Operating Features:
 - a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
 - b. Override switch.
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Bead Chain: No. 10 stainless steel chain rated to 90 pound minimum breaking strength.
 - a. Loop Length: Full length of roller shade unless otherwise indicated on Drawings.
 - b. Limit Stops: Provide upper and lower ball stops.

2. Provide Spring Lift-Assist Mechanisms for shades as recommended by manufacturer: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
- C. Roller Window Shade Components:
1. General: Provide hardware with regular drive and offset drive, reversible for left or right hand operation.
 2. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service. Provide shade rollers reversible for left- or right-hand operation.
 3. Shadeband-to-Roller Attachment: Manufacturer's standard method, enabling shadecloth to be removed without having to remove the tube from retainer brackets or without removing brackets.
- D. Shadeband Retention System: Manufacturer's standard system for guiding shadeband through range of travel and holding shadeband taut with edges of shadeband supported by side channels or angles.
- E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.
- F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- G. Shadebands:
1. Shadeband Material: Environmentally Certified Shadecloth.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.
- H. Accessories:
1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 4 inches.

2. Guide Cables: Provide guide cables where recommended by Roller Window Shade Manufacturer.

2.4 FABRICATION

- A. Product Safety Standard: Fabricate roller window shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Take field measurements before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of roller window shade system. Record field measurements on the submitted shop drawings. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay required installation schedules.
- C. Fabricate units to completely fill openings from head to sill and jamb to jamb, measured at 74 deg F, unless specifically indicated otherwise on the Drawings. Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
- D. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
 3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

2.5 FACTORY FINISHES

- A. Aluminum Components: Baked enamel in manufacturer's standard colors.
- B. Steel Components: Corrosion resistant-plated, satin-finished, or bonderized prior to painting with baked-enamel finish.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine surfaces to receive the roller window shades. Installation of roller window shades constitutes acceptance of the existing conditions and substrates by the installer of the roller window shades and the roller window shade manufacturer.
- B. If deteriorated or unacceptable conditions are encountered, immediately contact the Architect.

3.2 INSTALLATION

- A. Install roller window shades, accessories and controls complete, level, plumb, and aligned with adjacent units in accordance with roller window shade manufacturer's printed instructions, and the final reviewed shop drawings. Surface mount roller window shades as shown on the Drawings.
- B. Anchoring:
 - 1. Determine the locations, quantities, capacity and design for anchors and fasteners used in the installation subject to review by the Architect.
 - 2. Provide anchorage devices and fasteners as required to anchor, secure or attach the window shades, accessories and controls to the in place or subsequent construction, including but necessarily limited to bolts, nuts, screws, clips, washers, toggle bolts and other devices required to complete the installation of each window shade assembly.
 - 3. Drill required holes in construction for anchorage of window shades and accessories. Remove and replace damaged construction.
- C. Electrical Wiring:
 - 1. Provide electrical devices including any transformers required for voltage changes, controls and wiring between such, as required for the proper operation of the motorized roller window shade as specified for the types of electrical power available in the building.
- D. Install units within the following tolerances:
 - 1. Maximum variation of gap at window opening perimeter: 1/4 inch, per 8 feet (+/- 1/8 inch) of shade height.
 - 2. Maximum offset from level: 1/8 inch.
 - 3. Follow Manufacturer's edge-clearance specifications for shades where the width-to-height (W:H) ratio exceeds 1:3.

3.3 ADJUSTING

- A. Adjust units for smooth operation. Adjust shade and shadecloth to hang flat without buckling or distortion. Replace units or components which do not hang properly or operate smoothly.

3.4 CLEANING

- A. Touch up damaged finishes and repair minor damage in order to eliminate evidence of repair. Remove and replace work that cannot be satisfactorily repaired.
- B. Clean exposed surfaces, including metal and shadecloth, using non-abrasive materials and methods recommended by the Window Shadecloth Manufacturer. Remove and replace work which cannot be satisfactorily cleaned.

3.5 DEMONSTRATION

- A. Demonstrate operation method and instruct Owner's personnel in the proper operation and maintenance of the roller window shades.

3.6 PROTECTION

- A. After installation, cover and protect exposed portions of the units from damage.
- B. Just prior to final acceptance, remove protective coverings and clean surfaces as recommended by roller window shade manufacturer.

END OF SECTION

SECTION 12 36 23

PLASTIC LAMINATE COUNTERTOPS

PART 1 GENERAL

1.1 SUMMARY

- A. Fabricated plastic laminate countertops, including the following:
 - 1. Custom fabricated counters.
 - 2. Fabrication and installation hardware and accessories.
 - 3. Site installation.
- B. Related Sections:
 - 1. Metal fabrications: Section 05 50 00.
 - 2. Rough carpentry: Section 06 10 00.
 - 3. Architectural wood casework: 06 41 00.

1.2 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: Submit shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, hardware, finishes, anchors and other components. Indicate compliance with specified standards and other specified requirements for materials and workmanship.
- C. Samples: Samples will be reviewed for appearance and finish only. Compliance with other requirements is the exclusive responsibility of the Contractor.
 - 1. Submit sample chains of plastic laminate and backer sheet for color and pattern selection by Architect.
- D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.3 INFORMATIONAL SUBMITTALS

- A. Certification: Copies of certificate signed by the Fabricator/Installer, certifying that the work complies with the quality standards, grades and other requirements as referenced and specified herein.
 - 1. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

- A. Fabricator/Installer: A firm which has successfully produced and installed counters similar to the quality specified and in the quantity shown for a period of not less than 5 years. Provide evidence of qualifications and experience to Architect upon request.
- B. Reference Standards: Comply with the applicable provisions for grading and workmanship of the Architectural Woodwork Institute (AWI), latest standards, herein referred to as Standards, except as otherwise specified.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect counters during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver counters until painting, wet work, grinding and similar operations which could damage, soil or deteriorate counters has been completed in installation areas. If, due to unforeseen circumstances, counters must be stored in other than installation areas, store only in area which meet the requirements specified for installation areas.

1.6 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: Do not install counters until the required temperature and relative humidity have been stabilized in installation areas. Condition counters to average prevailing humidity and temperature conditions in installation areas prior to installing.

- B. Field Measurements: Where countertops are indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing countertops; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with manufacture of countertops without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.
- C. Coordination: Coordinate sizes and locations of framing, blocking, reinforcements, and other related units of work specified in other Sections to ensure that countertops can be supported and installed as indicated.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Plastic Laminate: Comply with requirements of Publication No. LD 3 by the National Electrical Manufacturers Association (NEMA) for General Purpose Type (HGS and VGS), nominal 0.048 inch thick and Postforming Type (HGP and VGP), nominal 0.038 inch thick. Colors, patterns and texture selected by the Architect with a maximum of three (3) colors being utilized in the plastic laminate fabrications from samples of the following manufacturers:
 - 1. Formica Corporation, Cincinnati, OH 45241.
 - 2. Lamin-Art, Schaumburg, IL 60173.
 - 3. Nevamar, Panolam Industries, Shelton, CT 06484
 - 4. Pionite Decorative Surfaces, Auburn, ME 04210.
 - 5. Wilsonart LLC, Temple, Texas 76503.
 - 6. Abet Inc., Englewood, NJ 07631.
 - 7. Apra USA, Jacksonville, FL 32218.
- B. Backing Sheet: Plastic laminate manufacturer's standard products complying with BKS/-91.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde
- D. Countertop Construction Materials: Provide materials that comply with requirements of the AWI woodworking standard for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:

1. Hardboard: ANSI/AHA A135.4.
 2. Medium Density Particleboard: ANSI A208.1.
 3. Medium Density Fiberboard: ANSI A208.2, Grade MD.
 4. Medium Density Fiberboard: Industrial Grade Medium Density Fiberboard (MDF), manufactured with a formaldehyde-free adhesive system which meets the requirements of ANSI A208.2, Grade 150, as manufactured by one of the following:
 - a. Flakeboard Company Limited
 - b. McKillican International, Inc.
 - c. Sierrapine Ltd.
 5. Softwood Plywood: PS 1
 6. Medium Density Overlay: 3/4 inch thick plywood, APA Grade MDO.
- E. Countertop Wire Control Grommets: Plastic grommet with spring loaded cover, color selection by Architect to match counter plastic laminate, one of the following:
1. "Flip-Top" (Doug Mockett & Co., Manhattan Beach, CA 90266).
 2. "No. 429.99.324 (black)" (Hafele America, CO., Archdale, NC 27263).
 3. "No. PL6200" (Hardware Concepts, Inc., Opa Locka, FL 33054).

2.2 FABRICATION OF COUNTERS

- A. Examine conditions and verify dimensions at the project site. Fabrication and/or installation of the counters and related elements shall constitute acceptance of the existing conditions.
- B. Not all details of counters are shown on the Drawings. The fabricator shall utilize the most advantageous manufacturing process to achieve the quality indicated herein by the referenced AWI Quality Standards and the details shown on the Drawings.
- C. Shop fabricate counters to the greatest extent possible, disassemble only as necessary for delivery and installation.
- D. Fabricate counters in accordance with the following requirements:
 1. Grade: AWI Custom Grade (Section 11), except as follows.
 2. Thickness and Style: As shown, or if not shown, provide minimum 3/4 inch thick counters, except where required to be thicker by Standards or as shown on the Drawings.

3. Counter Construction: 3/4 inch thick, phenolic resin sealed medium density particleboard compatible with laminate adhesives, with full backer sheets, as shown on Drawings, or if details not shown, comply with Standards and provide 4 inch high back-splash and end-splash, top-mounted square butt joints, fully covered with matching plastic laminate, eased edges.
 4. Exposed Counter Edges:
 - a. Plastic laminate matching surface, except as otherwise indicated. Ease exposed edges of overlap sheet.
 - b. When show on the Drawings, fabricate counters and counter edges using postforming plastic laminate to form rounded counter edges.
 5. Openings:
 - a. Cut openings for equipment to be installed. Comply with equipment manufacturer's requirements, but provide internal corners of 1/8 inch minimum radius. Smooth saw cut and ease edges.
 - b. Seal cut edges of counter at openings for sinks and other "wet" equipment, using waterproofing compound recommended by plastic manufacturer and compatible with laminating adhesive.
 6. Splashes:
 - a. Fabricate counters with backsplashes and sidesplashes. Fabricate to thicknesses and heights shown on the Drawings. If not shown provide minimum 4 inch high x 3/4 inch thick backsplashes and sidesplashes with exposed surface covered with plastic laminate.
 - b. When show on the Drawings, fabricate counters and splashes using postforming plastic laminate to form integral counter splash cove.
- E. Fabricate with scribes to fit to abutting construction.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify measurements at the project site and provide any necessary closures and trim to fit the items to enclosing walls and construction. Provide other trades with information necessary for proper completion of related work. Installation of counters and related construction shall constitute acceptance of the existing conditions.
- B. Condition counters to average prevailing humidity conditions in installation areas prior to installing.

3.2 INSTALLATION

- A. Install plumb, level, true and straight with no distortions. Shim as required using concealed shims.
- B. Where counters abuts other finished work, scribe and cut for accurate fit. Before making cutouts, drill pilot holes at corners.
- C. Attach counters securely in place with uniform joints providing for thermal and building movements. Secure to anchors or blocking built in or directly attached to substrates.
- D. Provide tops fabricated in largest sizes practical. Assemble in field with splines for alignment and drawn tight to hairline contact with tight joint fasteners.

3.3 CLEANING AND PROTECTION

- A. Protection: protect materials, installed counters, and finishes from damage by the work until acceptance of the work by the Owner. Maintain the required temperature/humidity conditions during the remainder of the construction period in areas of installation.
- B. Repair or remove and replace defective Work that cannot be repaired as directed upon completion of installation.

END OF SECTION

SECTION 21 00 00

GENERAL REQUIREMENTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The work includes the furnishing of all materials, supplies, labor, equipment, tools, transportation, facilities and services necessary for and required in connection with or properly incidental to all work, as shown on the drawings and specified herein or reasonably implied therefore. Contractor shall be responsible for his own required cutting and patching. Contact utility companies, municipal agencies and J.U.L.I.E. services.
- B. Accomplish necessary demolition and removal work, including but not limited to piping.
- C. Contractor shall provide all temporary services required to maintain normal building operation during construction. Temporary interruption of services shall occur during non-school hours. Contractor shall be solely responsible for determining construction sequencing and shall include all costs required for maintaining fire protections services to entire facility.
- D. Include in the Bid all costs for system testing.

1.2 DRAWINGS

- A. Drawings for this work consist of area zoning plans and detailed drawings and diagrams to which will be added, during the period of construction any other detail drawings as may be necessary in the opinion of the Owner's representative to show the proper installation of various appliances or equipment. These drawings and diagrams show arrangement and size of connection and shall be considered as part of, and complementing the specifications. They shall be followed as closely as actual building construction will permit. For all locations of fixtures, partitions and all other details of construction, this contractor shall consult the architectural drawings before submitting his bid to make sure all equipment will fit in the assigned space. Failure to do so does not relieve this contractor from installing the system complete in all details as described and shown.
- B. The drawings for this work accompanying these specifications are to be considered as an integral part of same and anything omitted from one and embodied in the other is to be considered essential to the requirements of the contract and must be furnished and installed by this contractor.
- C. Should the drawings and specifications contradict each other, the matter should be referred to the Owner's representative for his interpretation and correction before signing the contract. Otherwise, this contractor shall be held responsible for and he shall meet the requirements without extra cost to the Owner.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant and fire pump flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Standard and regulations: The work under the these sections shall comply with the latest editions of the following applicable standards, in addition to local (city) and state codes:
 - 1. ASME: American Society of Mechanical Engineers
 - 2. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers
 - 3. ACRI: Air Conditioning and Refrigeration Institute
 - 4. ASTM: American Society of Testing Materials
 - 5. ANSI: American National Standards Institute
 - 6. NFPA: National Fire Protection Association
 - 7. UL: Underwriter's Laboratories
 - 8. NEMA: National Electrical Manufacturers' Association
 - 9. NEC: National Electrical Code
 - 10. AGA: American Gas Association
 - 11. ISC: Illinois School Code 175 (supersedes 156A)
 - 12. ADA: Americans with Disabilities Act
 - 13. BOCA: Building Officials and Code Administrators
 - 14. IMC: International Fire Code
 - 15. IBC: International Building Code
- C. Include all items of labor and material required to comply with such codes in accordance with the contract documents. Where quantities, sizes or other requirements indicated on the drawings or herein specified are in excess of code requirements, the specifications and/or drawings shall govern regardless of code requirements.

1.4 SUBMITTALS

- A. At the completion of the work covered by this contract, this contractor shall be responsible for furnishing a complete set of certified as-built drawings showing the heating, ventilating, air conditioning, plumbing and fire protection work as it was actually installed so as to make a permanent record. As-builts shall be furnished to Owner electronically in AutoCAD format. As-builts shall be uniformly drafted at 1/4" scale.

1.5 SHOP DRAWINGS

- A. Submit to the Owner's representative copies of a list of the materials which he proposes to use in the execution of his contract. If any items are omitted from the list, such undeclared items shall be furnished strictly as specified. Provide manufacturer's certified drawings for all equipment as herein specified.

- B. Manufacturer's standard drawings will be accepted for manufacturer's standard production items if verified for installation at the location noted. Shop drawings shall be made for all items of equipment specially fabricated for this contract. Installation drawings shall show, in detail, the work to be installed by this contractor and the clearances, spaces, provisions or requirements for the work of the other contractors. When phrase "by others" appears on shop drawings, indicate who is to furnish material or operations so marked.
- C. Quarter-inch (1/4") scale piping shop drawings and hydraulic calculations shall be submitted for review. Shop drawings shall contain all required installation information including, but not limited to:
 - 1. Bottom of pipe height.
 - 2. Pipe size, lengths.
 - 3. All fittings.
 - 4. Hangers and supports.
 - 5. Indicate all coordination conflicts with other trades.
- D. Note: All equipment and piping shall be weather protected at all times. Non-protected material and equipment will be rejected and removed from the project without exception.

1.6 RULES AND REGULATIONS

- A. All workmanship and materials shall conform and comply with the requirements of the building ordinances and rules and regulations of all departments and bureaus of the County and State of Illinois having lawful jurisdiction irrespective of any statements herein to the contrary.
- B. All changes in the work of this contract which may be required by the said departments or bureaus or by the law or ordinances, when approved and ordered by the Owner's representative, shall be made by this contractor without extra cost to the Owner.
- C. One final inspection will be conducted for completion of work after written notification from the contractor. Additional inspections will be conducted at the expense of the contractor.

1.7 MATERIALS AND WORKMANSHIP

- A. All materials used throughout this installation shall be the best of their respective kind, and same shall be installed in a neat, accurate and workmanlike manner. This workmanship and these materials must be executed and furnished in a manner entirely satisfactory to the Owner's representative.
- B. Wherever in the specifications a particular article or material is definitely mentioned, it shall be provided and no substitutions will be allowed, especially insofar as the submittal of the base bid is concerned. Should the contractor desire to substitute other materials for those specified, he may submit these substitutions in the form of alternates to the base bid designating appropriate additions or deductions for each alternate.
- C. Final approval of all equipment will be by the Owner's representative.
- D. All materials used shall be asbestos free.

1.8 SUBSTANTIAL AND FINAL COMPLETION

- A. The contractor shall provide written notification to the engineer that the project is substantially complete. The engineer will accomplish a substantial completion inspection and provide the contractor with a list of work requiring corrective action. Upon completion of the corrective work, the contractor shall provide written notice that all corrective work has been completed. The engineer will conduct an inspection of the corrective work. The contractor shall bear costs of correcting such work, including additional testing and inspections, and compensation for the engineer's services and expenses made necessary thereby.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COORDINATION

- A. It is presumed that the contractor has carefully examined the drawings and specifications for the entire work and the job conditions which will ensure before submitting his bid and has reported to the Owner's representative in writing any interferences or conflicts with his work.
- B. If the contractor has failed to call such interferences or conflicts relative to his work and the drawings, specifications, the work of other contractors in the event of separate contracts and job conditions to the Owner's representative's attention in writing prior to execution of the contract, it will be presumed that no conflicts exist.
- C. When conflicts arise during the construction period, they shall be immediately reported to the Owner's representative in writing and they will be subject to the Owner's representative's decision. Contractor shall submit coordinated 1/4-inch scale shop drawings. Drawings shall indicate multiple conduit runs.

3.2 PROJECT CONDITIONS

- A. Existing Building Systems: Contractor shall provide all temporary services required to maintain all building systems in working order during construction. Temporary interruption of building systems shall only occur during non-school hours. Contractor shall be solely responsible for determining construction sequencing and shall include all costs required for maintaining all systems throughout the entire facility.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect at least two weeks in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
 - 2. Indicate method of providing temporary utilities.

3. Do not proceed with utility interruptions without Architect's written permission.

3.3 COOPERATION OF CONTRACTORS

- A. Each contractor, in laying out his work, shall cooperate with the other contractors on the work so as to avoid any interferences with their work. If this is not done, Owner's representative reserves the right to make such changes in the work as are necessary to avoid interferences and such changes will not be considered as cause for additional compensation or extension of time for the contractor.

3.4 JURISDICTION OF WORK

- A. Where it becomes necessary for contractor in order to fulfill his contract to furnish labor or materials other than that which is generally accepted by trade agreement or general practice to belong to his particular trade or branches of work, the contractor shall submit same to subcontractor engaged in the type of work involved to the end that there will be no stoppage of work due to violations of trade agreements as to jurisdiction.
- B. All cutting, patching, and fire safeing related to this contractor's work shall be accomplished by this contractor. All fire safeing material will be as directed by the architectural specification.

3.5 DEFECTIVE WORK AND MATERIALS

- A. All materials or work found to be defective, or not in strict conformity with the drawings, or different from the requirements of the drawings and specifications, or defaced or injured through negligence of this contractor or his employees, or through the action of fire, shall immediately be removed from the premises by this contractor and satisfactory material and work substituted therefore without delay.
- B. Any defected work or imperfect work which may be discovered shall be corrected immediately upon notice from the Owner's representative.

3.6 BASIS OF DESIGN

- A. Contract documents have been designed using scheduled/specified equipment manufacturers. Use of a specified acceptable manufacturer that requires changes in design shall be completed by the contractor at no additional cost to the Owner.

3.7 COORDINATION AND COOPERATION

- A. Coordinate the work with the other contractors on this project and also coordinate the work in this contract with the Local Authorities Having Jurisdiction.
- B. All work shall be so arranged that there will be no delay in the proper installation and completion of any part or parts of all piping and sheet metal

duct systems and mechanical equipment and the equipment shall be installed in proper sequence with other trades without any unnecessary delay.

- C. Should it be necessary, detailed drawings of a proposed departure due to actual field conditions or other causes shall be submitted to the Owner's representative for approval.
- D. Cover with all other contractors engaged in the construction of the project whose work may in any way affect his installation, and whenever interferences might occur and before installing any of the work in question, this contractor shall consult with them as to the exact location and level of his piping and ductwork and/or other parts of his equipment. This contractor shall be solely responsible for the proper arrangement of his piping and equipment.

3.8 ACCESS PANELS

- A. Arrange piping so that all concealed valves and/or concealed equipment can be operated and/or properly maintained through access panels. Contractor shall be responsible for coordinating locations with architect. Contractor shall furnish and install proper number and rated access panels required for his work. Access panels shall be 18-inch x 18-inch or larger as required.

3.9 FIRE-STOPS

- A. Penetrations through fire rated walls and floors shall be sealed to the original hourly fire rating with a fire-stop system capable of preventing the passage of flames and hot gases when subject to the requirements of the test standards specific for Fire-Stops ASTM E119 and E814 (UL 1479).

3.10 INSTRUCTIONS AND TRAINING

- A. Each contractor shall instruct Owner's personnel in the operation and maintenance of equipment installed. In addition, each contractor shall furnish to Owner three (3) sets of typewritten instructions on the operation and maintenance of each piece of equipment. Each contractor shall also furnish to Owner three (3) sets of equipment maintenance and operations manuals for each item of equipment.
- B. In addition to written instructions and manufacturer's training requirements, the contractors shall provide field training sessions as follows:

Contractor	Minimum No. of Sessions	Minimum Hours of Instruction
Sprinkler	1	4

- C. Training session scheduling requests shall be presented to Owner's representatives seven days prior to date for scheduling of all Owner's personnel.
- D. For each session, the contractor shall submit a training session log prepared by the contractor and signed by the Owner and contractor, certifying that the above has been satisfactorily completed and that the Owner's operations manuals and written instruction were on hand at the time of the session.

- E. All training sessions shall be video taped by the contractor and two copies shall be given to the Owner.
- F. The training sessions shall be coordinated by the contractor to avoid numerous trips by Owner's personnel. Training should be combined when possible.

END OF SECTION

SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Sleeves.
 - 3. Escutcheons.
 - 4. Grout.
 - 5. Fire-suppression equipment and piping demolition.
 - 6. Painting and finishing.
 - 7. Supports and anchorages.

1.3 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 rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Escutcheons.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 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 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 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.

2.3 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 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 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. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.5 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 and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, 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.

2.6 GROUT

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

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

- A. Refer to "Cutting and Patching" and "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. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 3. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean and store equipment. When appropriate, reinstall, reconnect and make equipment operational.
- 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.

3.2 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 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 slopes required to drain system. Install drain valves with hose connections at all low points.
- 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, where heat tracing is installed.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.

- h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
 - i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 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. 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.
- E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in "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.

3.5 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 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 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.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to "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.

3.7 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.

END OF SECTION

SECTION 21 05 53

IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Equipment signs.
 - 4. Access panel and door markers.
 - 5. Pipe markers.
 - 6. Valve tags.
 - 7. Valve schedules.
 - 8. Warning tags.
 - 9. Ceiling grid markers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

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

1.5 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 location of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - 1. Data: Instructions for operation of equipment and for safety procedures.
 - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 - 3. Thickness: 1/16 inch, unless otherwise indicated.
 - 4. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
 - 5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
 - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers. Provide 5/32-inch hole for fastener.
1. Material: 0.032-inch-thick brass.
 2. Material: 0.0375-inch-thick stainless steel.
 3. Material: 3/32-inch-thick laminated plastic with 2 black surfaces and white inner layer.
 4. Valve-Tag Fasteners: Brass wire-link, beaded chain, or S-hook.

2.4 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 2. Frame: Extruded aluminum.
 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

2.6 CEILING GRID MARKERS

- A. Ceiling Grid Markers: Self-adhesive round, 1/2 inch diameter color coding removable labels.
 - 1. Similar to Avery® Model 5050, 5051, 5052, or 5053.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Divisions 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Pumps and similar motor-driven units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Fire department hose valves and hose stations.
 - b. Meters, gages, thermometers, and similar units.
 - c. Pumps and similar motor-driven units.

- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. **Green:** For cooling equipment and components.
 - b. **Yellow:** For heating equipment and components.
 - c. **Orange:** For combination cooling and heating equipment and components.
 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Pumps and similar motor-driven units.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 1. Valve-Tag Size and Shape:
 - a. Fire Protection: 1-1/2 inches, round.
 2. Valve-Tag Color:
 - a. Fire Protection: Natural.
 3. Letter Color:
 - a. Fire Protection: Black.

3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 CEILING GRID MARKER INSTALLATION

- A. Install ceiling grid markers on lay-in tile ceiling grid, ceiling access panels and wall access panels. Locate markers visible from occupied space to identify mechanical equipment, valves, dampers, etc., located above.
- B. Ceiling Grid Markers Schedule:
 1. Equipment: Red, Avery® 5051
 2. Valves: Green, Avery® 5052
 3. Dampers: Blue, Avery® 5050
 4. Control Device: Orange, Avery® 5062
- C. If schedule requires different color labels in one location, install all colors required for proper identification.

3.8 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

- A. Clean faces of mechanical identification devices.

END OF SECTION

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Sprinklers.
 - 4. Alarm devices.
 - 5. Manual control stations.
 - 6. Control panels.
 - 7. Pressure gages.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

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

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Contractor shall perform a fire pump test prior to design.
 - 2. Contractor shall perform fire-hydrant flow test prior to design.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 (or as required by local authority) percent, including losses through water-service piping, valves, and backflow preventers.

2. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - e. Classrooms, Office and Public Areas: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft area.
4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:
 - a. Classroom, Office Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Domestic water piping.
 2. HVAC hydronic piping.
 3. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- E. Qualification Data: For qualified Installer and professional engineer.
- F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- G. Welding certificates.
- H. Fire pump test report.
- I. Fire-hydrant flow test report.

- J. 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."
- K. Field quality-control reports.
- L. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
 - B. 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.
 - D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than five days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

1.9 COORDINATION

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

1.10 EXTRA MATERIALS

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

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Schedule 40 Galvanized and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Thinwall Galvanized and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- C. Galvanized and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 2. Pressure Rating: 175 psig minimum.
 3. Galvanized painted or uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions.

Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig
- B. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 - 2. Standard: UL 1091 except with ball instead of disc.
 - 3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 - 4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - 5. Valves NPS 3: Ductile-iron body with grooved ends.
- C. Iron Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - 2. Standard: UL 1091.
 - 3. Pressure Rating: 175 psig.
 - 4. Body Material: Cast or ductile iron.
 - 5. Style: Lug or wafer.
 - 6. End Connections: Grooved.
- D. Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Tyco Fire & Building Products LP.

- c. Victaulic Company.
 2. Standard: UL 312.
 3. Pressure Rating: 250 psig.
 4. Type: Swing check.
 5. Body Material: Cast iron.
 6. End Connections: Flanged or grooved.
- E. Bronze OS&Y Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
 2. Standard: UL 262.
 3. Pressure Rating: 175 psig.
 4. Body Material: Bronze.
 5. End Connections: Threaded.
- F. Iron OS&Y Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. Tyco Fire & Building Products LP.
 2. Standard: UL 262.
 3. Pressure Rating: 250 psig.
 4. Body Material: Cast or ductile iron.
 5. End Connections: Flanged or grooved.
- G. NRS Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Mueller Co.; Water Products Division.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
 2. Standard: UL 262.
 3. Pressure Rating: 250 psig.
 4. Body Material: Cast iron with indicator post flange.
 5. Stem: Nonrising.
 6. End Connections: Flanged or grooved.
- H. Indicator Posts:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Mueller Co.; Water Products Division.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
 2. Standard: UL 789.
 3. Type: Horizontal for wall mounting.

4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Wrench.

2.5 TRIM AND DRAIN VALVES

- A. General Requirements:
 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating: 175 psig minimum.
- B. Angle Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.
- C. Ball Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fire Protection Products, Inc.
 - c. Milwaukee Valve Company.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.

2.6 SPECIALTY VALVES

- A. General Requirements:
 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
 3. Body Material: Cast or ductile iron.
 4. Size: Same as connected piping.
 5. End Connections: Flanged or grooved.
- B. Alarm Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 2. Standard: UL 193.
 3. Design: For horizontal or vertical installation.
 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
 5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
 6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

- A. Branch Outlet Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 2. Standard: UL 213.
 3. Pressure Rating: 175 psig.
 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 5. Type: Mechanical-T and -cross fittings.
 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: 175 psig.
 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.
- C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
 2. Standard: UL 199.
 3. Pressure Rating: 175 psig.
 4. Body Material: Brass.
 5. Size: Same as connected piping.
 6. Inlet: Threaded.
 7. Drain Outlet: Threaded and capped.
 8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.

- c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: 175 psig.
 4. Body Material: Cast- or ductile-iron housing with sight glass.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
 2. Standard: UL 1474.
 3. Pressure Rating: 250 psig.
 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 5. Size: Same as connected piping.
 6. Length: Adjustable.
 7. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Globe Fire Sprinkler Corporation.
 2. Reliable Automatic Sprinkler Co., Inc.
 3. Tyco Fire & Building Products LP.
 4. Victaulic Company.
 5. Viking Corporation.
- B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
 2. Nonresidential Applications: UL 199.
 3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
1. Chrome plated.
 2. Bronze.
 3. Painted.
- E. Special Coatings:
1. Wax.
 2. Lead.

3. Polyester.
 4. Corrosion-resistant paint.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Plastic, white finish, one piece, flat.
 2. Sidewall Mounting: Plastic, white finish, one piece, flat.
- G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 2. Standard: UL 346.
 3. Water-Flow Detector: Electrically supervised.
 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 5. Type: Paddle operated.
 6. Pressure Rating: 250 psig.
 7. Design Installation: Horizontal or vertical.
- C. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.

5. Design: Signals that controlled valve is in other than fully open position.
- D. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled indicator-post valve is in other than fully open position.
- 2.10 PRESSURE GAGES
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AMETEK; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
 - B. Standard: UL 393.
 - C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
 - D. Pressure Gage Range: 0 to 250 psig.
 - E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install alarm devices in piping systems.
- I. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- J. Install pressure gages on riser or feed main, at each sprinkler test connection. 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.
- K. Fill sprinkler system piping with water.
- L. Install sleeves for piping penetrations of walls, ceilings, and floors.
- M. Install escutcheons for piping penetrations of walls, ceilings, and floors.

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.
- F. 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.
- G. 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.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. 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.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. 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.
- C. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.7 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. Coordinate with fire-alarm tests. Operate as required.
 6. Coordinate with fire-pump tests. Operate as required.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
 - D. Prepare test and inspection reports.
- 3.8 CLEANING
- A. Clean dirt and debris from sprinklers.
 - B. Remove and replace sprinklers with paint other than factory finish.
- 3.9 PIPING SCHEDULE
- A. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:
 1. Standard-weight Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 5, shall be one of the following:
 1. Standard-weight, Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Thinwall, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - C. Standard-pressure, wet-pipe sprinkler system, NPS 6 and larger, shall be one of the following:
 1. Thinwall, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - D. Piping Fittings and Couplings located in pool areas and/or corrosive environments to be Hot-Dipped Galvanized.
- 3.10 SPRINKLER SCHEDULE
- A. Use sprinkler types in subparagraphs below for the following applications:
 1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Concealed sprinklers.
 3. Wall Mounting: Sidewall sprinklers.
 4. Spaces Subject to Freezing: Upright sprinklers, Pendent Dry Sprinklers, Sidewall Dry Sprinklers.
 5. Special Applications: Extended-coverage, sprinklers where indicated.
 - B. Provide sprinkler types in subparagraphs below with finishes indicated.
 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed

to view; wax coated or polyester where exposed to acids, chemicals, or other corrosive fumes and pool areas.

END OF SECTION

SECTION 22 00 00

GENERAL REQUIREMENTS FOR PLUMBING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The work includes the furnishing of all materials, supplies, labor, equipment, tools, transportation, facilities and services necessary for and required in connection with or properly incidental to all work, as shown on the drawings and specified herein or reasonably implied therefore. Contractor shall be responsible for his own required cutting and patching. Contact utility companies, municipal agencies and J.U.L.I.E. services.
- B. Accomplish necessary demolition and removal work, including but not limited to piping, insulation, fixtures, etc.
- C. Contractor shall provide all temporary services required to maintain normal building operation during construction. Temporary interruption of services shall occur during non-school hours. Contractor shall be solely responsible for determining construction sequencing and shall include all costs required for maintaining all mechanical, plumbing, and electrical services to entire facility during school year.
- D. Training of Owner's personnel.

1.2 DRAWINGS

- A. Drawings for this work consist of plumbing plans and detailed drawings and diagrams to which will be added, during the period of construction any other detail drawings as may be necessary in the opinion of the Owner's representative to show the proper installation of various appliances or equipment. These drawings and diagrams show arrangement and size of connection and shall be considered as part of, and complementing the specifications. They shall be followed as closely as actual building construction will permit. For all locations of fixtures, partitions and all other details of construction, this contractor shall consult the architectural drawings before submitting his bid to make sure all equipment will fit in the assigned space. Failure to do so does not relieve this contractor from installing the system complete in all details as described and shown.
- B. The drawings for this work accompanying these specifications are to be considered as an integral part of same and anything omitted from one and embodied in the other is to be considered essential to the requirements of the contract and must be furnished and installed by this contractor.
- C. Should the drawings and specifications contradict each other, the matter should be referred to the Owner's representative for his interpretation and correction before signing the contract. Otherwise, this contractor shall be held

responsible for and he shall meet the requirements without extra cost to the Owner.

1.3 QUALITY ASSURANCE

- A. Standard and regulations: The work under the mechanical sections shall comply with the latest editions of the following applicable standards, in addition to local (city) and state codes:
1. ASME: American Society of Mechanical Engineers
 2. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers
 3. ACRI: Air Conditioning and Refrigeration Institute
 4. ASTM: American Society of Testing Materials
 5. ANSI: American National Standards Institute
 6. NFPA: National Fire Protection Association
 7. UL: Underwriter's Laboratories
 8. NEMA: National Electrical Manufacturers' Association
 9. NEC: National Electrical Code
 10. AGA: American Gas Association
 11. ISC: Illinois School Code 175 (supersedes 156A)
 12. ADA: Americans with Disabilities Act
 13. BOCA: Building Officials and Code Administrators
 14. IPC: International Plumbing Code
 15. IBC: International Building Code
 16. Illinois State Plumbing Code
- B. Include all items of labor and material required to comply with such codes in accordance with the contract documents. Where quantities, sizes or other requirements indicated on the drawings or herein specified are in excess of code requirements, the specifications and/or drawings shall govern regardless of code requirements.

1.4 SUBMITTALS

- A. At the completion of the work covered by this contract, this contractor shall be responsible for furnishing a complete set of certified as-built drawings showing the heating, ventilating, air conditioning, and plumbing work as it was actually installed so as to make a permanent record. As-builts shall be furnished to Owner on reproducible sepia mylars and electronically in AutoCAD format. As-builts shall be uniformly drafted at 1/4" scale.

1.5 SHOP DRAWINGS

- A. Submit to the Owner's representative copies of a list of the materials which he proposes to use in the execution of his contract. If any items are omitted from the list, such undeclared items shall be furnished strictly as specified. Provide manufacturer's certified drawings for all equipment as herein specified.
- B. Manufacturer's standard drawings will be accepted for manufacturer's standard production items if verified for installation at the location noted. Shop drawings shall be made for all items of equipment specially fabricated for this contract. Installation drawings shall show, in detail, the work to be installed by

this contractor and the clearances, spaces, provisions or requirements for the work of the other contractors. When phrase "by others" appears on shop drawings, indicate who is to furnish material or operations so marked.

- C. Quarter-inch (1/4") scale piping and ductwork shop drawings shall be submitted for review. Shop drawings shall contain all required installation information including, but not limited to:
 - 1. Bottom of pipe height.
 - 2. Pipe size.
 - 3. All fittings.
 - 4. Hangers and supports.
 - 5. Insulation/lining size and location.
 - 6. Indicate all coordination conflicts with other trades.
- D. Note: All equipment and piping shall be weather protected at all times. Non-protected material and equipment will be rejected and removed from the project without exception.

1.6 RULES AND REGULATIONS

- A. All workmanship and materials shall conform and comply with the requirements of the building ordinances and rules and regulations of all departments and bureaus of the County and State of Illinois having lawful jurisdiction irrespective of any statements herein to the contrary.
- B. All changes in the work of this contract which may be required by the said departments or bureaus or by the law or ordinances, when approved and ordered by the Owner's representative, shall be made by this contractor without extra cost to the Owner.
- C. One final inspection will be conducted for completion of work after written notification from the contractor. Additional inspections will be conducted at the expense of the contractor.

1.7 MATERIALS AND WORKMANSHIP

- A. All materials used throughout this installation shall be the best of their respective kind, and same shall be installed in a neat, accurate and workmanlike manner. This workmanship and these materials must be executed and furnished in a manner entirely satisfactory to the Owner's representative.
- B. Wherever in the specifications a particular article or material is definitely mentioned, it shall be provided and no substitutions will be allowed, especially insofar as the submittal of the base bid is concerned. Should the contractor desire to substitute other materials for those specified, he may submit these substitutions in the form of alternates to the base bid designating appropriate additions or deductions for each alternate.
- C. Final approval of all equipment will be by the Owner's representative.
- D. All materials used shall be asbestos free.

1.8 SUBSTANTIAL AND FINAL COMPLETION

- A. The contractor shall provide written notification to the engineer that the project is substantially complete. The engineer will accomplish a substantial completion inspection and provide the contractor with a list of work requiring corrective action. Upon completion of the corrective work, the contractor shall provide written notice that all corrective work has been completed. The engineer will conduct an inspection of the corrective work. The contractor shall bear costs of correcting such work, including additional testing and inspections, and compensation for the engineer's services and expenses made necessary thereby.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COORDINATION

- A. It is presumed that the contractor has carefully examined the drawings and specifications for the entire work and the job conditions which will ensure before submitting his bid and has reported to the Owner's representative in writing any interferences or conflicts with his work.
- B. If the contractor has failed to call such interferences or conflicts relative to his work and the drawings, specifications, the work of other contractors in the event of separate contracts and job conditions to the Owner's representative's attention in writing prior to execution of the contract, it will be presumed that no conflicts exist.
- C. When conflicts arise during the construction period, they shall be immediately reported to the Owner's representative in writing and they will be subject to the Owner's representative's decision. Contractor shall submit coordinated 1/4-inch scale shop drawings. Drawings shall indicate multiple conduit runs.

3.2 PROJECT CONDITIONS

- A. Existing Building Systems: Contractor shall provide all temporary services required to maintain all building systems in working order during construction. Temporary interruption of building systems shall only occur during non-school hours. Contractor shall be solely responsible for determining construction sequencing and shall include all costs required for maintaining all mechanical, plumbing, and electrical systems throughout the entire facility during the school year.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Architect at least two weeks in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
 2. Indicate method of providing temporary utilities.

3. Do not proceed with utility interruptions without Architect's written permission.

3.3 COOPERATION OF CONTRACTORS

- A. Each contractor, in laying out his work, shall cooperate with the other contractors on the work so as to avoid any interferences with their work. If this is not done, Owner's representative reserves the right to make such changes in the work as are necessary to avoid interferences and such changes will not be considered as cause for additional compensation or extension of time for the contractor.

3.4 JURISDICTION OF WORK

- A. Where it becomes necessary for contractor in order to fulfill his contract to furnish labor or materials other than that which is generally accepted by trade agreement or general practice to belong to his particular trade or branches of work, the contractor shall submit same to subcontractor engaged in the type of work involved to the end that there will be no stoppage of work due to violations of trade agreements as to jurisdiction.
- B. All cutting, patching, and fire safeing related to this contractor's work shall be accomplished by this contractor. All fire safeing material will be as directed by the architectural specification.

3.5 DEFECTIVE WORK AND MATERIALS

- A. All materials or work found to be defective, or not in strict conformity with the drawings, or different from the requirements of the drawings and specifications, or defaced or injured through negligence of this contractor or his employees, or through the action of fire, shall immediately be removed from the premises by this contractor and satisfactory material and work substituted therefore without delay.
- B. Any defected work or imperfect work which may be discovered shall be corrected immediately upon notice from the Owner's representative.

3.6 BASIS OF DESIGN

- A. Contract documents have been designed using scheduled/specified equipment manufacturers. Use of a specified acceptable manufacturer that requires changes in design shall be completed by the contractor at no additional cost to the Owner.

3.7 COORDINATION AND COOPERATION

- A. Coordinate the plumbing work with the other contractors on this project and also coordinate the mechanical work in this contract with the local gas company.
- B. All work shall be so arranged that there will be no delay in the proper installation and completion of any part or parts of all piping and sheet metal

duct systems and mechanical equipment and the equipment shall be installed in proper sequence with other trades without any unnecessary delay.

- C. Should it be necessary, detailed drawings of a proposed departure due to actual field conditions or other causes shall be submitted to the Owner's representative for approval.
- D. Cover with all other contractors engaged in the construction of the project whose work may in any way affect his installation, and whenever interferences might occur and before installing any of the work in question, this contractor shall consult with them as to the exact location and level of his piping and ductwork and/or other parts of his equipment. This contractor shall be solely responsible for the proper arrangement of his piping and equipment.

3.8 ACCESS PANELS

- A. Arrange piping so that all concealed valves and/or concealed equipment can be operated and/or properly maintained through access panels. Contractor shall be responsible for coordinating locations with architect. Contractor shall furnish and install proper number and rated access panels required for his work. Access panels shall be 18-inch x 18-inch or larger as required.

3.9 FIRE-STOPS

- A. Penetrations through fire rated walls and floors shall be sealed to the original hourly fire rating with a fire-stop system capable of preventing the passage of flames and hot gases when subject to the requirements of the test standards specific for Fire-Stops ASTM E119 and E814 (UL 1479).

3.10 INSTRUCTIONS AND TRAINING

- A. Each contractor shall instruct Owner's personnel in the operation and maintenance of equipment installed. In addition, each contractor shall furnish to Owner three (3) sets of typewritten instructions on the operation and maintenance of each piece of equipment. Each contractor shall also furnish to Owner three (3) sets of equipment maintenance and operations manuals for each item of equipment.
- B. In addition to written instructions and manufacturer's training requirements, the contractors shall provide field training sessions as follows:

Contractor	Minimum No. Of Sessions	Minimum Hours Of Instruction
Plumbing	1	4

- C. Training session scheduling requests shall be presented to Owner's representatives seven days prior to date for scheduling of all Owner's personnel.
- D. For each session, the contractor shall submit a training session log prepared by the contractor and signed by the Owner and contractor, certifying that the above has been satisfactorily completed and that the Owner's operations manuals and written instruction were on hand at the time of the session.

- E. All training sessions shall be video taped by the contractor and two copies shall be given to the Owner.
- F. The training sessions shall be coordinated by the contractor to avoid numerous trips by Owner's personnel. Training should be combined when possible.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Sleeves.
 - 4. Grout.
 - 5. Plumbing demolition.
 - 6. Equipment installation requirements common to equipment sections.
 - 7. Painting and finishing.
 - 8. Concrete bases.
 - 9. Supports and anchorages.

1.3 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.

1.4 SUBMITTALS

- A. Transition Fittings: Manufacturer's data.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for 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.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for 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 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 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.

2.3 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 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 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. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 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. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Available Manufacturer(s):
 - a. Eslon Thermoplastics.
- 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.
 - 1. Available Manufacturer(s):
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Available Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- 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.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.5 GROUT

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

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to "Cutting and Patching" and "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing 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. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 3. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment. Provide Owner with right of refusal. If owner wants equipment deliver to designated location. If Owner declines equipment contractor shall dispose of according to all applicable rules and regulations.
- 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.

3.2 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 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 required slopes for proper drainage.
- 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. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to "Penetration Firestopping" for materials.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 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. 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.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

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

3.5 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.

3.6 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in "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.

3.7 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 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 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.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to "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.

3.9 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.

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Bronze ball valves.
 - 3. Bronze lift check valves.
 - 4. Bronze swing check valves.
 - 5. Iron swing check valves.
 - 6. Bronze gate valves.
 - 7. Iron gate valves.
 - 8. 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.
 - 3. Division 22 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 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. PTFE: Polytetrafluorethylene plastic.
- F. OS&Y: Outside screw and yoke.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 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.

1.6 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

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- C. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- D. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
 2. Handlever: For quarter-turn valves NPS 6 and smaller, except plug valves.
 3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
- H. Valves in Insulated Piping: With 2-inch 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 and memory stops that are fully adjustable after insulation is applied.
 - a. Basis of Design Product: Subject to compliance with requirements, provide NIBCO Nib-seal handle extension or comparable product by one of the following:
 - 1) Conbraco Industries, Inc.; Apollo Div.
 - 2) Crane.
 3. Butterfly Valves: With extended neck.
- I. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves, ASME B16.5 for steel 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.
- J. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 150, Bronze Angle Valves with Nonmetallic Disc:
1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T-335-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. Powell Valves.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Copper-Silicon Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.3 BRONZE BALL VALVES

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

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-585-70 or T-585-70 or a comparable product by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Jamesbury, Inc.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Milwaukee Valve Company.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
 - e. Body Material: Bronze ASTM B 584 Alloy C844.
 - f. Ends: Threaded or solder.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-585-70-66 or T-585-70-66 or a comparable product by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Jamesbury, Inc.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Milwaukee Valve Company.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece steel with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
 - e. Body Material: Bronze ASTM B 584 Alloy C844.
 - f. Ends: Threaded or Solder.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.
- 2.4 BRONZE LIFT CHECK VALVES
- A. Class 125, Lift Check Valves with Nonmetallic TFE Disc:
1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-480-Y or T-480-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valves Group; Crane Valves.
 - b. Powell Valves.
 - c. Milwaukee Valve Co.
 2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig.
- c. Body Design: Vertical flow.
- d. Body Material: ASTM B 584 Alloy C844, bronze.
- e. Ends: Threaded or Solder.
- f. Disc: PTFE or TFE.

2.5 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-433-Y or T-433-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. Powell Valves.
 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Y-pattern Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or Solder.
 - f. Disc: PTFE or TFE.

2.6 IRON SWING CHECK VALVES

- A. Class 150, Ductile-Iron Swing Check Valves with Metal Seats:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-9138-31 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell, Wm. Co.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 285 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 395, ductile iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.7 BRONZE GATE VALVES

- A. Class 150, NRS Bronze Gate Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-136 or T-136 or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO Valves.
 2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 300 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded or Solder.
- e. Stem: Copper-Silicon Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

2.8 IRON GATE VALVES

- A. Class 125, OS&Y, Cast-Iron Gate Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-617-O or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. Powell Valves.
 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig.
 - 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.

2.9 BRONZE GLOBE VALVES

- A. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-235-Y or T-235-Y or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. Powell Valves.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded or Solder.
 - e. Stem: Copper-Silicon Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, butterfly, gate, globe and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches 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. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Globe valves.
 - 4. Pump-Discharge Check Valves:

- a. NPS 2 and Smaller: Bronze swing or spring-loaded lift check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, or dual-plate metal or resilient-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, apply to this Section.
- B. Refer to architectural sheets for corrosive area designation.

1.2 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.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
- B. Related Sections include the following:
 - 1. "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

3. Powder-actuated fastener systems.
 4. Pipe positioning systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Fiberglass strut systems. Include Product Data for components.
 4. Pipe stands. Include Product Data for components.
 5. Equipment supports.
- C. Manufacturers hot dipped galvanized coating and duplex coating procedures and certifications.
- D. Welding certificates.
- 1.6 QUALITY ASSURANCE
- A. 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

2.1 MANUFACTURERS

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

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
1. AAA Technology & Specialties Co., Inc.
 2. Bergen-Power Pipe Supports.
 3. B-Line Systems, Inc.; a division of Cooper Industries.
 4. Carpenter & Paterson, Inc.
 5. Empire Industries, Inc.
 6. ERICO/Michigan Hanger Co.
 7. Globe Pipe Hanger Products, Inc.
 8. Grinnell Corp.
 9. GS Metals Corp.
 10. National Pipe Hanger Corporation.
 11. PHD Manufacturing, Inc.
 12. PHS Industries, Inc.

- 13. Piping Technology & Products, Inc.
- 14. Tolco Inc.

- C. Galvanized Metallic Coating and Hot Dipped Galvanized Coating. After Fabrication, minimum 3 Mil thickness.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.
- B. Hot Dipped Galvanized Coating: After fabrication, minimum 3 Mil thickness; ASTMA23.
- C. Duplex Coating: After fabrication consists of a minimum 3 Mil thickness, Hot Dipped Galvanized coating. ASTMA123, followed by a painted finish (ASTMD6386).

2.4 METAL FRAMING SYSTEMS

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

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.

- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, hot dipped, zinc-coated or stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.

- C. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Available Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 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, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish, or are located in corrosive locations including all Pool areas.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 15. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 16. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 17. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 18. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 19. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): 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.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. 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. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- 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 "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. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. 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.
- O. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.

7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 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.

3.5 ADJUSTING

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

3.6 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.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Equipment signs.
 - 4. Access panel and door markers.
 - 5. Pipe markers.
 - 6. Valve tags.
 - 7. Valve schedules.
 - 8. Ceiling grid markers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

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

1.5 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 location of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - 1. Data: Instructions for operation of equipment and for safety procedures.
 - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 - 3. Thickness: 1/16 inch, unless otherwise indicated.
 - 4. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
 - 5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
 - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: **Use piping system terms indicated and abbreviate only as necessary for each application length.**
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.
- 2.3 VALVE TAGS
- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers. Provide 5/32-inch hole for fastener.
1. Material: 0.032-inch-thick brass.
 2. Valve-Tag Fasteners: Brass wire-link, beaded chain, or S-hook.
- 2.4 VALVE SCHEDULES
- A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 2. Frame: Extruded aluminum.
 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

2.6 CEILING GRID MARKERS

- A. Ceiling Grid Markers: Self-adhesive round, 1/2 inch diameter color coding removable labels.
 - 1. Similar to Avery® Model 5050, 5051, 5052, or 5053.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Divisions 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units, including boilers and heaters.
 - 2. Pumps and similar motor-driven units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.

- d. Fuel-burning units, including boilers and heaters.
 - e. Pumps and similar motor-driven units.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. **Green:** For cooling equipment and components.
 - b. **Yellow:** For heating equipment and components.
 - c. **Orange:** For combination cooling and heating equipment and components.
 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers and heaters.
 - c. Pumps and similar motor-driven units.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations 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 nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - c. Gas: 1-1/2 inches, round.
 2. Valve-Tag Color:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 - c. Gas: Yellow.
 3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.
 - c. Gas: Black.

3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 CEILING GRID MARKER INSTALLATION

- A. Install ceiling grid markers on lay-in tile ceiling grid, ceiling access panels and wall access panels. Locate markers visible from occupied space to identify mechanical equipment, valves, dampers, etc., located above.
- B. Ceiling Grid Markers Schedule:
 1. Equipment: Red, Avery® 5051

2. Valves: Green, Avery® 5052
 3. Control Device: Orange, Avery® 5062
- C. If schedule requires different color labels in one location, install all colors required for proper identification.
- 3.8 ADJUSTING
- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- 3.9 CLEANING
- A. Clean faces of mechanical identification devices.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - 2. Adhesives.
 - 3. Mastics.
 - 4. Lagging adhesives.
 - 5. Sealants.
 - 6. Factory-applied jackets.
 - 7. Field-applied jackets.
 - 8. Tapes.
 - 9. Securements.
 - 10. Corner angles.
- B. Related Sections include the following:
 - 1. Division 23 Section Insulation sections.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 5. Detail application of field-applied jackets.
- C. Qualification Data: For qualified Installer.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test

results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program 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.
- C. Insulation shall not be applied until all surfaces are clean, dry and free of dirt, dust, grease, frost, moisture and other extraneous elements.

1.5 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.
- B. Insulation shall be stored inside and weather protected at all times.

1.6 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.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 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, HPC or HCFC blowing agents in the manufacturing process, and shall be formaldehyde free.
- F. Glass fiber pipe insulation shall have a minimum of 20 percent post-consumer recycled content.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM E 96, ASTM C 177, ASTM C 518 and ASTM C 534, Type I for tubular materials and Type II for sheet materials. Insulation shall have a thermal conductivity of 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F, and a maximum water vapor transmission of 0.08 PERM-inches.
 - 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.
- H. Glass-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article. Insulation shall have a thermal conductivity of 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Johns Manville; 800 Series Spin-Glas.
 - c. Knauf Insulation; Insulation Board.
 - d. Owens Corning; Fiberglas 700 Series.
- I. Glass-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following: Insulation shall have a thermal conductivity of 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F.
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000(Pipe Insulation).

- c. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article. Insulation shall have a thermal conductivity of 0.24 Btu x in./h x sq. ft. x deg F at 100 deg F.
- J. Glass-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 75 deg F is 0.24 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; MicroFlex.
 - b. Knauf Insulation; Pipe and Tank Insulation.
 - c. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 2. 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).
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; Encacel.
 - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
 - c. Marathon Industries, Inc.; 570.
 - d. Mon-Eco Industries, Inc.; 55-70.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 4. Service Temperature Range: Minus 50 to plus 180 deg F.
 5. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 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.

2.7 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.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. 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, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 2.5-mil-thick Polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick Polysurlyn.
 - 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.
- D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.
- 2.8 TAPES
- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

- A. Bands:
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. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
 4. 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, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 3. 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. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 2 inches in diameter.
 - c. Spindle: Nylon, 0.156-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-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. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.10 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 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.

3.2 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 with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.
- D. Insulation installed on wet pipe will be removed and replaced at no additional cost to the Owner.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment 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 supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches 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.
 - 6. Apply mastic to exposed ends of insulation systems operating above ambient.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

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

3.4 PENETRATIONS

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

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, 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. 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 over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 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. Install PVC jacket on all exposed insulated piping located indoors.
- F. Install aluminum or stainless steel jacketing on all insulated piping located outdoors and all heat traced piping.

3.7 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 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 glass-fiber blanket insulation.
 - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 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 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, 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. Install PVC jacket on all exposed insulated piping located indoors.
- F. Install aluminum or stainless steel jacketing on all insulated piping located outdoors and all heat traced piping.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch 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.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

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

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 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.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water: Insulate complete system.
 - 1. NPS 1 and Smaller: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Stormwater and Overflow: Insulate complete systems.
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies: Insulate complete system.
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch 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 the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- F. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- H. Hot Service Drains:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Glass-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
- I. Hot Service Vents:
 - 1. All Pipe Sizes: Insulation shall be the following:

- a. Glass-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Exposed: All Exposed Piping.
 - 1. PVC: 20 mils thick.

3.15 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Encasement for piping.
 - 3. Specialty valves.
 - 4. Escutcheons.
 - 5. Sleeves and sleeve seals.
 - 6. Wall penetration systems.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Dielectric fittings.
 - 3. Flexible connectors.
 - 4. Water meters.
 - 5. Backflow preventers and vacuum breakers.
 - 6. Escutcheons.
 - 7. Sleeves and sleeve seals.
 - 8. Water penetration systems.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. HVAC hydronic piping.
 - 4. Electrical equipment and conduit.
- D. Field quality-control reports.

1.4 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.

1.5 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 Construction Manager no fewer than two weeks in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Construction Manager's written permission.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L 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. Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch 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, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 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.

2.5 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - 2. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
 2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.
- F. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
 2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.
- 2.6 ESCUTCHEONS
- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
 - B. One Piece, Cast Brass: Polished, chrome-plated or rough-brass finish with setscrews.
 - C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
 - D. Split Casting, Cast Brass: Polished, chrome-plated or rough-brass finish with concealed hinge and setscrew.
 - E. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew.
 - F. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
 - G. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.7 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- 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 setscrews.

2.8 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.9 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. SIGMA.
- B. 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.

2.10 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in "Earth Moving" for excavating, trenching, and backfilling.

3.2 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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Sections for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.

- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.
- M. Install piping to permit valve servicing.
- N. 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.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Sections for pressure gages.
- S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats.
- T. Install thermometers on outlet piping from each water heater. Install thermometers on hot water recirculation piping up stream of pump. Comply with requirements in Division 22 Sections for thermometers.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. 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.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 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 and smaller. Use gate valves for piping NPS 2-1/2 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.

3.5 DIELECTRIC FITTING INSTALLATION

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

3.6 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 and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. 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
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.

3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 6. NPS 6: 10 feet with 5/8-inch rod.
 7. NPS 8: 10 feet with 3/4-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing according to MSS SP-69 and manufacturer's written instructions.

3.7 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. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 2. 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.
 3. 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 and larger.

3.8 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
- C. Escutcheons for Existing Piping:
1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.

2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish.
6. Bare Piping in Equipment Rooms: Split casting, cast brass.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.9 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 "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 "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 annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- I. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Stack sleeve fittings.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in "Sheet Metal Flashing and Trim" for flashing.
 - c. Caulk for water tight seal.
 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE.
 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - c. Do not use sleeves when wall penetration systems are used.
 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
- J. 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 "Penetration Firestopping" for firestop materials and installations.
- 3.10 SLEEVE SEAL INSTALLATION
- A. Install sleeve seals in sleeves in exterior concrete walls.
 - 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.
- 3.11 WALL PENETRATION SYSTEM INSTALLATION
- A. Install wall penetration systems in new, exterior concrete walls.
 - B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.
- 3.12 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.
- 3.13 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
 - B. 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.
- C. 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 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.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.14 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.

3.15 CLEANING

- A. Clean and disinfect domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.16 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 3 and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K non-fittings or joints under slab.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K; no fittings or joints under the slab.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.

3.17 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 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated, memory-stop 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.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Balancing valves.
 - 4. Temperature-actuated water mixing valves.
 - 5. Strainers.
 - 6. Drain valves.
 - 7. Water hammer arresters.
 - 8. Air vents.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1001.
 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: Threaded.
 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1011.
 3. Body: Bronze, nonremovable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1020.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

- A. Beverage-Dispensing-Equipment Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1022.
 3. Operation: Continuous-pressure applications.
 4. Size: NPS 1/4 or NPS 3/8.
 5. Body: Stainless steel.
 6. End Connections: Threaded.
- B. Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Mueller Co.; Water Products Div.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1024.
 3. Operation: Continuous-pressure applications.
 4. Body: Bronze with union inlet.

2.3 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 2. Type: Ball or 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.
 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- C. Memory-Stop Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.

- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Div.
- e. Hammond Valve.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Conbraco Industries, Inc.
 - c. Legend Valve.
 - 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 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 85 deg F.
9. Valve Finish: Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.

4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Threaded union inlets and outlet.
 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
 9. Tempered-Water Setting: 160 deg F.
 10. Valve Finish: Rough bronze.
 11. Piping Finish: Copper.
 12. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
- C. Individual-Fixture, Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
 3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 4. Body: Bronze body with corrosion-resistant interior components.
 5. Temperature Control: Adjustable.
 6. Inlets and Outlet: Threaded.
 7. Finish: Rough or chrome-plated bronze.
 8. Tempered-Water Setting: 110 deg F.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.062 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.125 inch.
 - c. Strainers NPS 5 and Larger: 0.25 inch.
 6. Drain: Factory-installed, hose-end drain valve.

2.6 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products Inc.
 - e. 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.

2.8 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install reduced-pressure-principle (RPZ) 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.
- 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 and bypass with globe valve. 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 fixture type thermostatic mixing valve at each lavatory, hand sink, etc.
- H. Install Y-pattern strainers for water on supply side of each control valve, solenoid valve, and pump.
- I. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in "Rough Carpentry."
- J. Install water hammer arresters in water piping according to PDI-WH 201.
- K. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 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."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Reduced-pressure-principle backflow preventers.
 - 3. Double-check backflow-prevention assemblies.
 - 4. Carbonated-beverage-machine backflow preventers.
 - 5. Dual-check-valve backflow preventers.
 - 6. Double-check, detector-assembly backflow preventers.
 - 7. Calibrated balancing valves.
 - 8. Primary, thermostatic, water mixing valves.
 - 9. Manifold, thermostatic, water-mixing-valve assemblies.
 - 10. Primary water tempering valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer 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.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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.
 - 3. Encasement for underground metal piping.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.4 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.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:
 - 1. Coordinated waste and vent piping plans.
- C. Field quality-control inspection and test reports.

1.6 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.

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 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 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.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. 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.
 - a. Available Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.

- 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) MG Piping Products Co.
 - C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 1. Available Manufacturers:
 - a. ANACO.
- 2.5 COPPER TUBE AND FITTINGS
- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
 - B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- 2.6 PVC PIPE AND FITTINGS - NOT PERMITTED IN PLENUM CEILING SPACES
- A. Solid-Wall 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.
 - B. Solvent Cement and Adhesive Primer:
 1. Use PVC solvent cement 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 that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 2.7 TRANSITION COUPLINGS
- 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. Available Manufacturers:
 - a. Dallas Specialty & Mfg. Co.

- b. Fernco, Inc.
 - c. Logan Clay Products Company (The).
 - d. Mission Rubber Co.
 - e. NDS, Inc.
 - f. Plastic Oddities, Inc.
2. 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.

2.8 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch minimum thickness.
- B. Form: Sheet or tube.
- C. Color: Black.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
NOT PERMITTED IN PLENUM CEILING SPACES.
 - 5. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Copper DWV tube, copper drainage fittings, and soldered joints.

4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
NOT PERMITTED IN PLENUM CEILING SPACES.
 5. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
NOT PERMITTED IN PLENUM CEILING SPACES.
 5. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
NOT PERMITTED IN PLENUM CEILING SPACES.
 5. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Extra-Heavy and Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Extra-Heavy and Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Sections.
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers. Locate full size cleanout within 5 feet of building main sanitary sewer connection(s).

- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- E. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- F. 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."
- G. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- H. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- I. Make changes in direction for soil 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.
- J. 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.
- K. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- M. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- N. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- O. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 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 hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- D. 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.
- E. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 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 and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install 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 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: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.

- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 5. NPS 6: 10 feet with 5/8-inch rod.
 - 6. NPS 8: 10 feet with 3/4-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.
- J. Install supports for vertical PVC piping every 48 inches.
- K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 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 and larger.

3.7 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 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. From 15 minutes before inspection starts 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. 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.

3.8 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.

3.9 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Roof flashing assemblies.
 - 4. Through-penetration firestop assemblies.
 - 5. Miscellaneous sanitary drainage piping specialties.
 - 6. Flashing materials.

1.3 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.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Clean outs.
 - 2. Floor drains.
 - 3. Trench drains.
 - 4. Miscellaneous sanitary drainage piping specialties.
 - 5. Flashing material.
- B. Shop Drawings: Show fabrication and installation details.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 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.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements as specified.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Unfinished Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - c. MIFAB.
 - 2. Standard: ASME A112.36.2M for cast iron or ASME A112.3.1 for stainless steel for cleanout test tee.
 - 3. Type: Adjustable housing.
 - 4. Body or Ferrule: Cast iron.
 - 5. Clamping Device: Required.
 - 6. Outlet Connection: Threaded No-Hub.
 - 7. Adjustable Housing Material: Cast iron with threads.
 - 8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - 9. Frame and Cover Shape: Square.
 - 10. Top Loading Classification: Extra Heavy Duty.
 - 11. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.
 - 12. Size: Same as connected drainage piping
 - 13. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
 - 14. Closure: Countersunk, brass plug.
 - 15. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Finished Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group.
 - c. MIFAB.
 - 2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.

3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Threaded No-Hub.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Square.
12. Top Loading Classification: Light or Medium Duty.
13. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Wall Cleanouts:

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.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with tamper resistant screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group.
 - c. MIFAB.
2. Standard: ASME A112.6.3.
3. Pattern: See drawings.
4. Body Material: Cast gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required where waterproof membrane is used.
8. Outlet: See drawings.
9. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel shall be used in all food service areas and corrosive areas.
10. Top or Strainer Material: Stainless steel.
11. Top of Body and Strainer Finish: Stainless steel.
12. Top Shape: See drawings.

13. See drawings for all specifics.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing 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. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 10 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- C. Sleeve Flashing Device:
 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- D. Stack Flashing Fittings:
 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- E. Frost-Resistant Vent Terminals:
 1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
 2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- F. Expansion Joints:
 1. Standard: ASME A112.21.2M.
 2. Body: Cast iron with bronze sleeve, packing, and gland.
 3. End Connections: Matching connected piping.
 4. Size: Same as connected soil, waste, or vent piping.

2.6 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Applications: 12 oz./sq. ft..
 2. Vent Pipe Flashing: 8 oz./sq. ft..
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.

- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install 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 or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 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.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Assemble open drain fittings and install with top of hub 2 inches above floor.
- I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

- K. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- L. Install wood-blocking reinforcement for wall-mounting-type specialties.
- M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- N. 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.

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. 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 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Faucets for lavatories and sinks.
 - 2. Laminar-flow faucet-spout outlets.
 - 3. Protective shielding guards.
 - 4. Commercial sinks.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Bathtubs: ANSI Z124.1.
 - 3. Plastic Lavatories: ANSI Z124.3.
 - 4. Plastic Laundry Trays: ANSI Z124.6.
 - 5. Plastic Mop-Service Basins: ANSI Z124.6.
 - 6. Plastic Shower Enclosures: ANSI Z124.2.
 - 7. Plastic Sinks: ANSI Z124.6.
 - 8. Plastic Urinal Fixtures: ANSI Z124.9.
 - 9. Plastic Whirlpool Bathtubs: ANSI Z124.1 and ASME A112.19.7M.
 - 10. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 11. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 12. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 13. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 14. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 15. Vitreous-China Fixtures: ASME A112.19.2M.
 - 16. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 17. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 18. Whirlpool Bathtub Fittings: ASME A112.19.8M.

- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 4. Faucets: ASME A112.18.1.
 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 8. NSF Potable-Water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Supply Fittings: ASME A112.18.1.
 12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Faucets: ASME A112.18.1.
 4. Hand-Held Showers: ASSE 1014.
 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Floor Drains: ASME A112.6.3.
 5. Grab Bars: ASTM F 446.
 6. Hose-Coupling Threads: ASME B1.20.7.

7. Hot-Water Dispensers: ASSE 1023 and UL 499.
8. Off-Floor Fixture Supports: ASME A112.6.1M.
9. Pipe Threads: ASME B1.20.1.
10. Plastic Shower Receptors: ANSI Z124.2.
11. Plastic Toilet Seats: ANSI Z124.5.
12. Supply and Drain Protective Shielding Guards: ICC A117.1.
13. Whirlpool Bathtub Equipment: UL 1795.

1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 2. Warranty Period for Commercial Applications: Three years from date of Substantial Completion.

1.7 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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
 3. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.

PART 2 - PRODUCTS

2.1 SINK FAUCETS

- A. Sink Faucets:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets.
 - b. Sloan Valve.
 - c. Zurn Plumbing Products Group; Commercial Brass Operation.
 2. Description: See Plans.

2.2 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.3 COMMERCIAL SINKS

- A. Commercial Sinks:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Elkay Manufacturing Co.
 - c. Just Manufacturing Company.
 - d. Kohler Co.
 2. Description: See Plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install wall-mounting fixtures with tubular waste piping attached to supports.
- C. Install counter-mounting fixtures in and attached to casework.
- D. Install fixtures level and plumb according to roughing-in drawings.
- E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate

within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- F. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
 - G. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
 - H. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - I. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
 - J. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - K. Install traps on fixture outlets.
 1. Exception: Omit trap on fixtures with integral traps.
 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
 - L. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
 - M. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
 - N. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants as specified.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- 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."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust hot-water dispensers and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 00 00

GENERAL REQUIREMENTS FOR HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The work includes the furnishing of all materials, supplies, labor, equipment, tools, transportation, facilities and services necessary for and required in connection with or properly incidental to all work, as shown on the drawings and specified herein or reasonably implied therefore. Contractor shall be responsible for his own required cutting and patching. Contact utility companies, municipal agencies and J.U.L.I.E. services.
- B. Use of the new equipment for temporary heating or cooling will not be approved.
- C. Accomplish necessary demolition and removal work, including but not limited to VAV and fan powered boxes, temperature control system, piping, exhaust fans, ductwork, grilles, etc.
- D. Contractor shall provide all temporary services required to maintain normal building operation during construction. Temporary interruption of services shall occur during non-school hours. Contractor shall be solely responsible for determining construction sequencing and shall include all costs required for maintaining all mechanical, plumbing, and electrical services to entire facility during school year.
- E. Furnish two spare sets of air filters and fan belts for each piece of equipment requiring filters and fan belts.
- F. Include in your bid all costs for equipment start-up services from manufacturer's technicians. Start-up services shall be provided for boilers, pumps, rooftop units, air handlers, and as specified herein.
- G. Training of Owner's personnel.

1.2 DRAWINGS

- A. Drawings for this work consist of mechanical plans and detailed drawings and diagrams to which will be added, during the period of construction any other detail drawings as may be necessary in the opinion of the Owner's representative to show the proper installation of various appliances or equipment. These drawings and diagrams show arrangement and size of connection and shall be considered as part of, and complementing the specifications. They shall be followed as closely as actual building construction will permit. For all locations of fixtures, partitions and all other details of construction, this contractor shall consult the architectural drawings before submitting his bid to make sure all equipment will fit in the assigned space.

Failure to do so does not relieve this contractor from installing the system complete in all details as described and shown.

- B. The drawings for this work accompanying these specifications are to be considered as an integral part of same and anything omitted from one and embodied in the other is to be considered essential to the requirements of the contract and must be furnished and installed by this contractor.
- C. Should the drawings and specifications contradict each other, the matter should be referred to the Owner's representative for his interpretation and correction before signing the contract. Otherwise, this contractor shall be held responsible for and he shall meet the requirements without extra cost to the Owner.

1.3 QUALITY ASSURANCE

- A. Standard and regulations: The work under the mechanical sections shall comply with the latest editions of the following applicable standards, in addition to local (city) and state codes:
 - 1. ASME: American Society of Mechanical Engineers
 - 2. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers
 - 3. ACRI: Air Conditioning and Refrigeration Institute
 - 4. ASTM: American Society of Testing Materials
 - 5. ANSI: American National Standards Institute
 - 6. NFPA: National Fire Protection Association
 - 7. UL: Underwriter's Laboratories
 - 8. NEMA: National Electrical Manufacturers' Association
 - 9. NEC: National Electrical Code
 - 10. AGA: American Gas Association
 - 11. ISC: Illinois School Code 175 (supersedes 156A)
 - 12. ADA: Americans with Disabilities Act
 - 13. BOCA: Building Officials and Code Administrators
 - 14. IMC: International Mechanical Code
 - 15. IBC: International Building Code
- B. Include all items of labor and material required to comply with such codes in accordance with the contract documents. Where quantities, sizes or other requirements indicated on the drawings or herein specified are in excess of code requirements, the specifications and/or drawings shall govern regardless of code requirements.

1.4 SUBMITTALS

- A. At the completion of the work covered by this contract, this contractor shall be responsible for furnishing a complete set of certified as-built drawings showing the heating, ventilating, air conditioning, plumbing and fire protection work as it was actually installed so as to make a permanent record. As-builts shall be furnished to Owner on reproducible sepia mylars and electronically in AutoCAD format. As-builts shall be uniformly drafted at 1/4" scale.

1.5 SHOP DRAWINGS

- A. Submit to the Owner's representative copies of a list of the materials which he proposes to use in the execution of his contract. If any items are omitted from the list, such undeclared items shall be furnished strictly as specified. Provide manufacturer's certified drawings for all equipment as herein specified.
- B. Manufacturer's standard drawings will be accepted for manufacturer's standard production items if verified for installation at the location noted. Shop drawings shall be made for all items of equipment specially fabricated for this contract. Installation drawings shall show, in detail, the work to be installed by this contractor and the clearances, spaces, provisions or requirements for the work of the other contractors. When phrase "by others" appears on shop drawings, indicate who is to furnish material or operations so marked.
- C. Quarter-inch (1/4") scale piping and ductwork shop drawings shall be submitted for review. Shop drawings shall contain all required installation information including, but not limited to:
 - 1. Bottom of duct/pipe height.
 - 2. Duct/pipe size.
 - 3. All fittings.
 - 4. Hangers and supports.
 - 5. Insulation/lining size and location.
 - 6. Indicate all coordination conflicts with other trades.
- D. Note: All equipment and ductwork shall be weather protected at all times. Non-protected material and equipment will be rejected and removed from the project without exception.

1.6 RULES AND REGULATIONS

- A. All workmanship and materials shall conform and comply with the requirements of the building ordinances and rules and regulations of all departments and bureaus of the County and State of Illinois having lawful jurisdiction irrespective of any statements herein to the contrary.
- B. All changes in the work of this contract which may be required by the said departments or bureaus or by the law or ordinances, when approved and ordered by the Owner's representative, shall be made by this contractor without extra cost to the Owner.
- C. One final inspection will be conducted for completion of work after written notification from the contractor. Additional inspections will be conducted at the expense of the contractor.

1.7 MATERIALS AND WORKMANSHIP

- A. All materials used throughout this installation shall be the best of their respective kind, and same shall be installed in a neat, accurate and workmanlike manner. This workmanship and these materials must be executed and furnished in a manner entirely satisfactory to the Owner's representative.
- B. Wherever in the specifications a particular article or material is definitely mentioned, it shall be provided and no substitutions will be allowed, especially

insofar as the submittal of the base bid is concerned. Should the contractor desire to substitute other materials for those specified, he may submit these substitutions in the form of alternates to the base bid designating appropriate additions or deductions for each alternate.

- C. Final approval of all equipment will be by the Owner's representative.
- D. All materials used shall be asbestos free.

1.8 SUBSTANTIAL AND FINAL COMPLETION

- A. The contractor shall provide written notification to the engineer that the project is substantially complete. The engineer will accomplish a substantial completion inspection and provide the contractor with a list of work requiring corrective action. Upon completion of the corrective work, the contractor shall provide written notice that all corrective work has been completed. The engineer will conduct an inspection of the corrective work. The contractor shall bear costs of correcting such work, including additional testing and inspections, and compensation for the engineer's services and expenses made necessary thereby.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COORDINATION

- A. It is presumed that the contractor has carefully examined the drawings and specifications for the entire work and the job conditions which will ensure before submitting his bid and has reported to the Owner's representative in writing any interferences or conflicts with his work.
- B. If the contractor has failed to call such interferences or conflicts relative to his work and the drawings, specifications, the work of other contractors in the event of separate contracts and job conditions to the Owner's representative's attention in writing prior to execution of the contract, it will be presumed that no conflicts exist.
- C. When conflicts arise during the construction period, they shall be immediately reported to the Owner's representative in writing and they will be subject to the Owner's representative's decision. Contractor shall submit coordinated 1/4-inch scale shop drawings. Drawings shall indicate multiple conduit runs.

3.2 PROJECT CONDITIONS

- A. Existing Building Systems: Contractor shall provide all temporary services required to maintain all building systems in working order during construction. Temporary interruption of building systems shall only occur during non-school hours. Contractor shall be solely responsible for determining construction sequencing and shall include all costs required for maintaining all mechanical,

plumbing, and electrical systems throughout the entire facility during the school year.

- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect at least two weeks in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
 - 2. Indicate method of providing temporary utilities.
 - 3. Do not proceed with utility interruptions without Architect's written permission.

3.3 COOPERATION OF CONTRACTORS

- A. Each contractor, in laying out his work, shall cooperate with the other contractors on the work so as to avoid any interferences with their work. If this is not done, Owner's representative reserves the right to make such changes in the work as are necessary to avoid interferences and such changes will not be considered as cause for additional compensation or extension of time for the contractor.

3.4 JURISDICTION OF WORK

- A. Where it becomes necessary for contractor in order to fulfill his contract to furnish labor or materials other than that which is generally accepted by trade agreement or general practice to belong to his particular trade or branches of work, the contractor shall submit same to subcontractor engaged in the type of work involved to the end that there will be no stoppage of work due to violations of trade agreements as to jurisdiction.
- B. All cutting, patching, and fire safeing related to this contractor's work shall be accomplished by this contractor. All fire safeing material will be as directed by the architectural specification.

3.5 DEFECTIVE WORK AND MATERIALS

- A. All materials or work found to be defective, or not in strict conformity with the drawings, or different from the requirements of the drawings and specifications, or defaced or injured through negligence of this contractor or his employees, or through the action of fire, shall immediately be removed from the premises by this contractor and satisfactory material and work substituted therefore without delay.
- B. Any defected work or imperfect work which may be discovered shall be corrected immediately upon notice from the Owner's representative.

3.6 BASIS OF DESIGN

- A. Contract documents have been designed using scheduled/specified equipment manufacturers. Use of a specified acceptable manufacturer that requires

changes in design shall be completed by the contractor at no additional cost to the Owner.

3.7 COORDINATION AND COOPERATION

- A. Coordinate the mechanical work with the other contractors on this project and also coordinate the mechanical work in this contract with the local gas company.
- B. All work shall be so arranged that there will be no delay in the proper installation and completion of any part or parts of all piping and sheet metal duct systems and mechanical equipment and the equipment shall be installed in proper sequence with other trades without any unnecessary delay.
- C. Should it be necessary, detailed drawings of a proposed departure due to actual field conditions or other causes shall be submitted to the Owner's representative for approval.
- D. Cover with all other contractors engaged in the construction of the project whose work may in any way affect his installation, and whenever interferences might occur and before installing any of the work in question, this contractor shall consult with them as to the exact location and level of his piping and ductwork and/or other parts of his equipment. This contractor shall be solely responsible for the proper arrangement of his piping and equipment.

3.8 ACCESS PANELS

- A. Arrange piping so that all concealed valves and/or concealed equipment can be operated and/or properly maintained through access panels. Contractor shall be responsible for coordinating locations with architect. Contractor shall furnish and install proper number and rated access panels required for his work. Access panels shall be 18-inch x 18-inch or larger as required.

3.9 FIRE-STOPS

- A. Penetrations through fire rated walls and floors shall be sealed to the original hourly fire rating with a fire-stop system capable of preventing the passage of flames and hot gases when subject to the requirements of the test standards specific for Fire-Stops ASTM E119 and E814 (UL 1479).

3.10 INSTRUCTIONS AND TRAINING

- A. Each contractor shall instruct Owner's personnel in the operation and maintenance of equipment installed. In addition, each contractor shall furnish to Owner three (3) sets of typewritten instructions on the operation and maintenance of each piece of equipment. Each contractor shall also furnish to Owner three (3) sets of equipment maintenance and operations manuals for each item of equipment.
- B. In addition to written instructions and manufacturer's training requirements, the contractors shall provide field training sessions as follows:

<u>Contractor</u>	<u>Minimum No. Of Sessions</u>	<u>Minimum Hours Of Instruction</u>
HVAC	2	8

- C. Training session scheduling requests shall be presented to Owner's representatives seven days prior to date for scheduling of all Owner's personnel.
- D. For each session, the contractor shall submit a training session log prepared by the contractor and signed by the Owner and contractor, certifying that the above has been satisfactorily completed and that the Owner's operations manuals and written instruction were on hand at the time of the session.
- E. All training sessions shall be video taped by the contractor and two copies shall be given to the Owner.
- F. The training sessions shall be coordinated by the contractor to avoid numerous trips by Owner's personnel. Training should be combined when possible.

3.11 BUILDING COMMISSIONING

- A. The mechanical contractor shall be responsible for the commission of the HVAC system as described below:
 - 1. All air filters shall be changed before the test and balance is performed.
 - 2. All equipment shall be checked for proper operation.
 - 3. The building systems shall be tested as follows:
 - a. The air conditioning system(s) shall be started and placed in full operation for a period of one week before the building is occupied.

3.12 CONTROLS COMMISSIONING

- A. All devices and points in the control system shall be thoroughly and systematically verified for proper installation, wiring, calibration, addressing, operations, etc.
- B. Provide five (5) copies of a commissioning report, which documents, in detail, the commissioning of each and every point and field device in the system. The commissioning report shall contain, as a minimum, the following data for each point and device:
 - 1. Point name.
 - 2. Device tag as shown on as-built drawings.
 - 3. Point type (analog input, analog output, binary input, binary output).
 - 4. Point address.
 - 5. Description of field device.
 - 6. Manufacturer of field device.
 - 7. Part number of field device.
 - 8. The computer state or value of the point as displayed on the CPU (temperature/pressure/humidity reading, on/off, % open/closed, etc.).
 - 9. The actual, measured value or state of the point. This data must be measured on a separate device such as a thermometer, pressure gauge, meter, etc.
 - 10. The signature of the temperature control contractor's employee who commissioned the point.

11. The date that the point was commissioned.
 - C. Provide a technician to demonstrate to the engineers/architects the operation of all control sequences, alarm activation, etc. Include eight (8) hours for this demonstration.
 - D. The temperature control contractor shall be responsible for providing one hour of technical check-out time per each piece of equipment to assist the balancing contractor at start-up. This time is separate from the temperature control start-up and commissioning described above.
 - E. An additional 10% over the normal contract amount to be held back from the temperature controls contractor until training and commissioning are completed and Owner has accepted.
- 3.13 CONTROLS TRAINING – TRAINING OF OWNER’S PERSONNEL
- A. Provide three (3) copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the system. Instruct the Owner's designated representatives in these procedures during the startup and test period. The duration of the instruction period shall be no less than (2 eight-hour sessions) 16 hours. These instructions are to be conducted during normal working hours. The instruction shall consist of both hands-on and classroom training at job site. The training of the building operator shall be held during the second week of August and subsequent sessions shall be held once the building system is operational. Substantial completion will not be initiated until this phase of training is completed. All training sessions shall be requested in writing to the Owners representative 7 days prior.
 - B. A second training session of eight hour sessions shall be provided when requested by the Owner.
 - C. If the contractor does not attend a scheduled training session, he will be back-charged for the Owner’s time and expenses.
- 3.14 CONTROL GUARANTEE
- A. The control system shall be free from defects in workmanship and material under normal use and service for two years from the date of substantial completion of the entire project. After completion of the installation, the control manufacturer/contractor shall regulate and adjust all thermostats, control valves, operators and other equipment provided under this contract during this period.
 - B. This warranty shall extend to material that is supplied and installed by the control manufacturer/contractor. Material supplied but not installed by the control manufacturer/contractor shall be covered per the above to the extent of the product only. Installation labor for valves and dampers shall be the responsibility of the company performing and installation covered during this period.
 - C. This warranty shall not start until training is completed and the control systems have been commissioned and accepted by the Owner.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. HVAC demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

1.3 DEFINITIONS

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

- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPE, TUBE, AND FITTINGS

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

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch 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 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. CPVC Piping: ASTM F 493.

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 1. Available Manufacturers:
 - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 1. Available Manufacturers:
 - a. Thompson Plastics, Inc.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, [CPVC] [PVC] [CPVC and PVC] four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 1. Available Manufacturers:
 - a. NIBCO INC.

2.5 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 minimum working pressure at 180 deg F.
 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. 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. Manufacturers:
 - a. Advance Products & Systems, Inc.

- b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

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

2.7 SLEEVES

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

- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- 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 and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, 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.

2.9 GROUT

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

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to "Cutting and Patching" and "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 indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

3. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 4. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 5. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 6. 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. Contractor is responsible for all isolation, draining, storage and refilling of system water/chemicals within piping being removed or connected into. Contractor to field verify all required isolation or lack there of and include all related costs in bid.

3.2 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 according to the following:
 1. New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
2. Existing Piping: Use the following:
- a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
 - i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor

- level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to "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 "Joint Sealants" for materials and installation.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- 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 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 "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.

3.3 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. 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. 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.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- 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.

3.4 PIPING CONNECTIONS

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

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in "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.

3.7 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 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 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.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to "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.

3.9 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.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. All motors shall be premium efficiency and suitable for a humid, corrosive, and salty environment. Motors shall be TEFC, suitable for variable speed drives and shall comply with IEEE 841 for severe-duty motors.
- B. Shaft Grounding System:
 - 1. Shaft grounding system to protect bearings from induced voltage.
 - 2. Shaft grounding system shall have low drag (less than 0.05 percent of motor horsepower), and shall operate for a minimum of three years without periodic maintenance or adjustments.
 - 3. Mounting: External or internal to motor enclosure.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SHAFT GROUNDING RINGS

- A. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR's Service Life: Designed to last for service life of motor. Provide AEGIS SGR Conductive MicroFiber Shaft Grounding Ring, or approved equal.
- B. Application Note: Motors up to 100 HP shall be provided with one shaft grounding ring installed on either the drive end or non-drive end. Grounding rings shall be provided and installed by the motor manufacturer and shall be installed in accordance with the shaft grounding ring manufacturer's recommendations.

2.4 HIGH-FREQUENCY BONDING:

- A. All motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high-frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection. Provide AEGIS HF Ground Straps, or equal.
- B. Application Note: High-frequency grounding straps must be used to ensure the proper grounding of all inverter-driven induction motor frames.

2.5 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 F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.6 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.

2.7 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.

2.8 ADDITIONAL REQUIREMENTS FOR MOTORS USED WITH VARIABLE FREQUENCY DRIVE

A. 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. 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.
- B. Shaft Grounding System:
1. Shaft grounding system to protect bearings from induced voltage.
 2. Shaft grounding system shall have low drag (less than 0.05 percent of motor horsepower), and shall operate for a minimum of three years without periodic maintenance or adjustments.
 3. Mounting: External or internal to motor enclosure.
 4. Shaft grounding rings shall be provided and installed by the motor manufacturer.
 5. High frequency bonding shall be installed.

PART 3 - EXECUTION

3.1 MOTOR SCHEDULE

- A. All motors shall be TEFC, rated for use with variable speed drive and severe duty.
- B. Shaft Grounding System:
 1. Shaft grounding system to protect bearings from induced voltage.
 2. Shaft grounding system shall have low drag (less than 0.05 percent of motor horsepower), and shall operate for a minimum of three years without periodic maintenance or adjustments.
 3. Mounting: External or internal to motor enclosure.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. Refer to architectural sheets for corrosive area designation.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 23 Section "Vibration Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 2. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

3. Powder-actuated fastener systems.
 - B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Pipe stands. Include Product Data for components.
 4. Equipment supports.
 - C. Manufacturers hot dipped galvanized coating and duplex coating procedures and certifications.
 - D. Welding certificates.
- 1.6 QUALITY ASSURANCE
- A. Welding: Qualify procedures and personnel according to the following:
 1. AWS D1.1, "Structural Welding Code--Steel."
 2. AWS D1.2, "Structural Welding Code--Aluminum."
 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 1. AAA Technology & Specialties Co., Inc.
 2. Bergen-Power Pipe Supports.
 3. B-Line Systems, Inc.; a division of Cooper Industries.
 4. Carpenter & Paterson, Inc.
 5. Empire Industries, Inc.
 6. ERICO/Michigan Hanger Co.
 7. Globe Pipe Hanger Products, Inc.
 8. Grinnell Corp.
 9. GS Metals Corp.
 10. National Pipe Hanger Corporation.
 11. PHD Manufacturing, Inc.
 12. PHS Industries, Inc.
 13. Piping Technology & Products, Inc.

14. Tolco Inc.

- C. Galvanized Metallic Coating: Hot Dipped Galvanized coating after fabrication, minimum 3 Mil thickness.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.
- B. Hot Dipped Galvanized Coating: After fabrication, minimum 3 mil thickness; ASTM A123.
- C. Duplex Coating: After fabrication, consists of a minimum 3 mil thickness, hot dipped galvanized coating; ASTM A123, followed by a painted finish (ASTM D 6386).

2.4 METAL FRAMING SYSTEMS

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

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type hot dipped zinc-coated or stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. MIRO Industries.

- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - 2. Base: Plastic or stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. Portable Pipe Hangers.
 - 2. Bases: One or more plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 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, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish or are located in corrosive locations including all pool areas.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 - 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 - 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 - 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 - 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): 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.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. 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.
 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.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- 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 "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. 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.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.

- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- N. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 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.

3.5 ADJUSTING

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

3.6 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.

END OF SECTION

SECTION 23 05 48

VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Housed spring mounts.
 - 4. Elastomeric hangers.
 - 5. Spring hangers.

1.3 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.

1.4 ACTION 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, and wind forces required to select vibration isolators, and wind restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Welding certificates.
- C. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Isolation Technology, Inc.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
- B. 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.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- D. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- E. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 FACTORY FINISHES

- A. 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

3.1 EXAMINATION

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

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- C. 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.
- D. 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.
- E. 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.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust active height of spring isolators.
- C. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 DEMONSTRATION

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

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Access panel and door markers.
 - 3. Duct markers.
 - 4. Warning tags.
 - 5. Ceiling grid markers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

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

1.5 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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
 - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.3 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

2.4 CEILING GRID MARKERS

- A. Ceiling Grid Markers: Self-adhesive round, 1/2 inch diameter color coding removable labels.
 - 1. Similar to Avery® Model 5050, 5051, 5052, or 5053.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Divisions 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - 2. Pumps, chillers, and similar motor-driven units.
 - 3. Cooling towers, heat recovery units, and similar equipment.
 - 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 - 5. Packaged HVAC central-station and zone-type units.
- B. Install access panel markers with screws on equipment access panels.

3.3 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
 - 1. **Green:** For cold-air supply ducts.
 - 2. **Yellow:** For hot-air supply ducts.
 - 3. **Blue:** For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
 - 5. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Stenciled Duct Marker Option: Stenciled markers, showing service and direction of flow, may be provided instead of laminated-plastic duct markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.4 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.5 CEILING GRID MARKER INSTALLATION

- A. Install ceiling grid markers on lay-in tile ceiling grid, ceiling access panels and wall access panels. Locate markers visible from occupied space to identify mechanical equipment, valves, dampers, etc., located above.
- B. Ceiling Grid Markers Schedule:
 - 1. Equipment: Red, Avery® 5051

2. Valves: Green, Avery® 5052
 3. Dampers: Blue, Avery® 5050
 4. Control Device: Orange, Avery® 5062
- C. If schedule requires different color labels in one location, install all colors required for proper identification.
- 3.6 ADJUSTING
- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- 3.7 CLEANING
- A. Clean faces of mechanical identification devices.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.

5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Architect, Owner, Construction Manager and Commissioning Authority on 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.
- C. Certify TAB field data reports and perform the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Construction Manager.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine 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 ceiling plenums return or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. 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.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. 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.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes 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.

3.3 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," ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2004, 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.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "Duct 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.

- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 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."

3.5 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.
 6. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- 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.
- 3.6 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 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.
 - 2. 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.
 - 3. 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.
 - 4. Record final fan-performance data.

3.7 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. 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.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.

3.9 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.

3.10 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 or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 - 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.11 REPORTING

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

3.12 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. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Pipe and valve sizes and locations.
 4. Terminal units.
 5. Balancing stations.
 6. Position of balancing devices.
- E. 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, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 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, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.

- d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
- F. 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 o.c.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - l. Inlet steam pressure in psig.
- G. 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, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 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, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
 - H. 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.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
 - I. 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.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
 - J. System-Coil Reports: For reheat 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.
 - b. Coil kw.
 - c. Coil stages, kw per stage.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
- K. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.13 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 10 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 Commissioning Authority.
 - 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
 - 3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 - 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.

3.14 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- B. Related Sections:
 - 1. Section 23 31 13 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 2. Detail application of field-applied jackets.
 - 3. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

- A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

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

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come 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. Glass-Fiber Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite XG.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Owens Corning; SOFTR All-Service Duct Wrap.
- G. Glass-Fiber Board Insulation: Glass or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Johns Manville; 800 Series Spin-Glas.
 - c. Knauf Insulation; Insulation Board.
 - d. Owens Corning; Fiberglas 700 Series.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive 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."
- C. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - b. Vimasco Corporation; 713 and 714.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - c. Mon-Eco Industries, Inc.; 44-05.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.

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

2.6 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White unless noted color as selected by Architect.
- C. Metal Jacket:
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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications 3-mil-thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick polysurlyn.
 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil-thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick polysurlyn.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
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. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.

4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
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. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

- A. Bands:
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. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.
 4. 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, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - 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) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 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) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. 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. Comply with the following requirements:
 - 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) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - 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) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.

- c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. 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-wide, stainless steel or Monel.
 - D. Wire: 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.
 - 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. C & F Wire.
- 2.10 CORNER ANGLES
- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
 - B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
 - C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Insulation securement material shall match ductwork material.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

- C. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- D. 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.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- 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.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

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

3.5 INSTALLATION OF GLASS-FIBER INSULATION

- A. 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, 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 deg F at 18-foot 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 two times the insulation thickness, but not less than 3 inches.
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches 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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. 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, 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 deg F at 18-foot 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 two times the insulation thickness, but not less than 3 inches.
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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch 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.

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

3.7 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in "Exterior Painting" and "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- 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 connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. Ft nominal density.
- B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. Ft nominal density.
- C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
 1. Round/flat-oval duct not permitted in this application.
- D. Concealed, round and flat-oval, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
 1. Round/flat-oval duct not permitted in this application.
- E. Concealed, rectangular, supply-air duct insulation shall be the following:
 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- F. Concealed, rectangular, return-air duct insulation in non-return plenum location shall be the following:
 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
 2. Return-air duct concealed and located within return-air plenum is not required to be insulated.
- G. Concealed, rectangular, outdoor-air duct insulation shall be the following:
 1. Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
 1. Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- I. Concealed, supply-air plenum insulation shall be the following:
 1. Glass-Fiber Board: 1 inch 3-lb/cu. ft. nominal density.
- J. Concealed, return-air plenum insulation shall be the following:
 1. Glass-Fiber Board: 1 inch thick and ft. 3-lb/cu. ft. nominal density.
- K. Concealed, outdoor-air plenum insulation shall be the following:
 1. Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- L. Concealed, exhaust-air plenum insulation between isolation damper and penetration of building exterior shall be the following:
 1. Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- M. Concealed, exhaust-air plenum insulation at penetration of building exterior shall be the following:

1. Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- N. Exposed, round and flat-oval, supply-air duct insulation shall be the following:
 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- O. Exposed, round and flat-oval, return-air duct insulation in non-conditioned space shall be the following:
 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
 2. Return-air duct exposed in conditioned space not required to be insulated.
- P. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:
 1. Glass-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
- Q. Exposed, round and flat-oval, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
 1. Glass-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
- R. Exposed, rectangular, supply-air duct within non-conditioned space, insulation shall be the following:
 1. Glass-Fiber Board: 2 inch thick and 3-lb/cu. ft. nominal density.
- S. Exposed, rectangular, supply-air duct within conditioned space, insulation shall be the following:
 1. Glass-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density
- T. Exposed, rectangular, return-air duct within conditioned space, insulation shall be the following:
 1. Insulation not required.
- U. Exposed, rectangular, return-air duct within non-conditioned space, insulation shall be the following:
 1. Glass-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density
- V. Exposed, rectangular, outdoor-air duct insulation shall be the following:
 1. 3 inches thick and 3-lb/cu. ft. nominal density.
- W. Exposed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
 1. 3 inches thick and 3-lb/cu. ft. nominal density.
- X. Exposed, supply-air plenum insulation shall be the following:
 1. Glass-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
- Y. Exposed, return-air plenum in non-conditioned space, insulation shall be the following:
 1. Glass-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.
- Z. Exposed, outdoor-air plenum insulation shall be the following:
 1. Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- AA. Exposed, exhaust-air plenum insulation between isolation damper and penetration of building exterior shall be the following:
 1. Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.

- BB. Concealed, exhaust-air plenum insulation at penetration of building exterior shall be the following:
 - 1. Glass-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density

3.11 OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation material and thickness are identified below. If more than one material is listed for a duct system, selection from the material listed is contractors option.
- B. Round and flat oval, supply air duct insulation shall be the following:
 - 1. Glass fiber board: 3 inches thick and 3 lb/cu-ft nominal density.
- C. Round and flat oval, return air duct insulation shall be the following:
 - 1. Glass fiber board: 2 inches thick and 3 lb/cu-ft nominal density.
- D. Rectangular supply air duct insulation shall be the following:
 - 1. Glass fiber board: 2 inches thick and 3 lb/cu-ft nominal density.
- E. Rectangular return air duct insulation shall be the following:
 - 1. Glass fiber board: 2 inches thick and 3 lb/cu-ft nominal density.
- F. Supply air plenum insulation shall be the following:
 - 1. Glass fiber board: 3 inches thick and 3 lb/cu-ft nominal density.
- G. Return air plenum insulation shall be the following:
 - 1. Glass fiber board: 2 inches thick and 3 lb/cu-ft nominal density.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 - 1. None.
- D. Insulated Ducts and Plenums, Exposed:
 - 1. None

3.13 OUTDOOR, 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. Ducts and Plenums:
 - 1. Aluminum, Stucco Embossed: 0.032 inch thick.

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 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. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.3 WARRANTY

- A. Twenty-four (24) months parts and labor.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
 - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.

6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. 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.
 - 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.
 - e. Ducted Air Temperature: Plus or minus 1 deg F.
 - f. Outside Air Temperature: Plus or minus 2 deg F.
 - g. Dew Point Temperature: Plus or minus 3 deg F.
 - h. Temperature Differential: Plus or minus 0.25 deg F.
 - 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.
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
 - 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.

1.5 SEQUENCE OF OPERATION

- A. See individual equipment sections.
- B. See Section 23 09 93.

1.6 ACTION 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. Written description of sequence of operation.
 - 6. Schedule of dampers including size, leakage, and flow characteristics.
 - 7. Schedule of valves including flow characteristics.
 - 8. 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.
 - 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 - 10. 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. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.
 - D. Samples for Verification: For each color required, of each type of thermostat or sensor cover.
- 1.7 INFORMATIONAL SUBMITTALS
- A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
 - B. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks.
 - C. Qualification Data: For Installer.
 - D. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
 - E. Field quality-control test reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in "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.
- B. Software and Firmware Operational Documentation: Include the following:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Software license required by and installed for DDC workstations and control systems.

1.9 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.

1.10 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.

1.11 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 26 Sections to achieve compatibility with equipment that interfaces with that system.

- C. Coordinate equipment with Section 28 31 11 "Fire-Alarm and Voice-Notification System" to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- E. Coordinate equipment with Division 26 Sections to achieve compatibility of communication interfaces.
- F. Coordinate equipment with Division 26 Sections to achieve compatibility with motor starters and annunciation devices.
- G. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements as specified.

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 CONTROL SYSTEM

- A. Manufacturers:
 - 1. Carrier Global Corporation: Automated Logic
 - a. Contact Erie Dones: 630-470-3705, Erie.Dones@carrier.com
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- 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 mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 DDC EQUIPMENT

- A. Application Software:
 - 1. I/O capability from operator station.
 - 2. System security for each operator via software password and access levels.
 - 3. Automatic system diagnostics; monitor system and report failures.
 - 4. Database creation and support.
 - 5. Automatic and manual database save and restore.
 - 6. Dynamic color graphic displays with up to 10 screen displays at once.

7. Custom graphics generation and graphics library of HVAC equipment and symbols.
 8. Alarm processing, messages, and reactions.
 9. Trend logs retrievable in spreadsheets and database programs.
 10. Alarm and event processing.
 11. Object and property status and control.
 12. Automatic restart of field equipment on restoration of power.
 13. Data collection, reports, and logs. Include standard reports for the following:
 - a. Current values of all objects.
 - b. Current alarm summary.
 - c. Disabled objects.
 - d. Alarm lockout objects.
 - e. Logs.
 14. Custom report development.
 15. Utility and weather reports.
 16. Workstation application editors for controllers and schedules.
 17. Maintenance management.
- B. Custom Application Software:
1. English language oriented.
 2. Full-screen character editor/programming environment.
 3. Allow development of independently executing program modules with debugging/simulation capability.
 4. Support conditional statements.
 5. Support floating-point arithmetic with mathematic functions.
 6. Contains predefined time variables.
- 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.

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
 6. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer 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.
 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
 5. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.
- 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 with three-position (on-off-auto) override switches and status lights.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
 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.

2.4 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 scheduling with real-time clock. 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. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
 5. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.5 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. Ebtron, Inc.
 - c. Heat-Timer Corporation.
 - d. I.T.M. Instruments Inc.
 - e. MAMAC Systems, Inc.
 - f. RDF Corporation.
 2. Accuracy: Plus or minus 0.5 deg F at calibration point.
 3. Wire: Twisted, shielded-pair cable.
 4. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 5. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
 6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.

7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 8. Room Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. RTDs and Transmitters:
1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. MAMAC Systems, Inc.
 - c. RDF Corporation.
 2. Accuracy: Plus or minus 0.2 percent at calibration point.
 3. Wire: Twisted, shielded-pair cable.
 4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 5. Averaging Elements: 24 feet long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 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.
 9. Humidity Sensors: Bulk polymer sensor element.
 - a. Accuracy: 2 percent full range with linear output.
 - b. Room Sensor Range: 20 to 80 percent relative humidity.
 - c. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
 - d. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.
 - e. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- D. Pressure Transmitters/Transducers:
1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; 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.

2.6 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, 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.

2.7 THERMOSTATS

- A. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- B. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 2. Selector Switch: Integral, manual on-off-auto.
- C. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
 1. Bulbs in water lines with separate wells of same material as bulb.
 2. Bulbs in air ducts with flanges and shields.

3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
- D. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- E. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- F. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- G. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft of coil surface.
- 2.8 HUMIDISTATS
- A. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.
- 2.9 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 Section 23 05 13 "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: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
 - a. Belimo Aircontrols (USA), Inc.
 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
 4. Coupling: V-bolt and V-shaped, toothed cradle.
 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 7. Power Requirements (Two-Position Spring Return): 24-V ac.
 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 10. Temperature Rating: Minus 22 to plus 122 deg F.
 11. Run Time: 12 seconds open, 5 seconds closed.

2.10 DAMPERS

- A. Manufacturers:
1. Air Balance Inc.
 2. Don Park Inc.; Autodamp Div.
 3. TAMCO (T. A. Morrison & Co. Inc.).
 4. United Enertech Corp.
 5. Vent Products Company, Inc.
- B. Dampers: AMCA-rated, parallel or opposed-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with nylon 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.
 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.

4. 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. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that power supply is available to control units and operator workstation.
- B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 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 60 inches above the floor.
 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install automatic dampers according to Section 23 33 00 "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 Section 23 05 53 "Identification for HVAC Piping and Equipment."
- G. Install hydronic instrument wells, valves, and other accessories according to Division 23 Sections.
- H. Install duct volume-control dampers according to Section 23 31 13 "Metal Ducts."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- B. Install building wire and cable according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

- C. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- D. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. 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 calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak 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 instrument tubing for proper fittings, slope, material, and support.
 - 5. Check installation of air supply for each instrument.
 - 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 8. Check temperature instruments and material and length of sensing elements.
 - 9. Check control valves. Verify that they are in correct direction.
 - 10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 - 11. 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.

3.5 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 analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliamper meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. 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.

- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 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 "Demonstration and Training."

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Section 23 09 00 "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. VAV: Variable air volume.

1.4 FPB - FAN POWERED TERMINAL AIR UNITS WITH ELECTRIC COILS

- A. Space temperature sensor reports temperature to system, which then modulates VAV damper and coil control valve, in sequence, to maintain setpoint. All space temperature sensors shall have occupancy override button. Override button shall enable occupied mode for system serving space for period of 2 hours. VAV damper shall be at heating position (1/3 design CFM) when in heating mode. Room temperature sensor modulates control valve once VAV damper is at heating position (1/3 maximum flow).
- B. With AHU fan operating in occupied mode, sequence the controls as follows:
 - 1. Energize all terminal fans, energize central system fans, modulate volume damper to maintain room temperature.
 - 2. On reduced-cooling demand, adjust volume damper closed to minimum position (1/3 of design CFM).
 - 3. As cooling demand increases, open volume damper.
 - 4. If no cooling or heating demand, control enters field-adjustable, no-load band.
 - 5. On heating demand, adjust volume damper to minimum position (1/3 of design CFM), and modulate electric heating coil to maintain room temperature.
 - 6. Interlock with radiant ceiling panel operation.
- C. With AHU fan not operating in unoccupied mode, sequence the controls as follows:

1. On heating demand, energize air terminal unit fan and heating valve.
 2. Maintain field-adjustable setback temperature.
 3. Close volume damper.
- D. With AHU in morning warm-up mode enable fan and electric heating coil, adjust damper to full open position. When space reaches occupied setpoint command space to occupied mode.
- E. With AHU in morning cool-down mode enable fan, adjust damper to full open position. When space reaches occupied setpoint command space to occupied mode.
- F. Minimum control points:
1. (AI) Space Temperature.
 2. (AI) Local Temperature Adjustment.
 3. (DO) Fan Control (enable/disable).
 4. (DI) Fan Status (current sensor).
 5. (AI) Terminal Unit Airflow.
 6. (AO) Terminal Unit Damper Modulation.
 7. (AO) Minimum CFM Setpoint.
 8. (AO) Maximum CFM Setpoint
 9. (AO) Electric Heating Coil Modulation.
 10. (DI) Occupancy Override.
- G. Signal alarm for the following conditions:
1. Space temperature is 3 degrees above or below room setpoint for more than 5 minutes.
 2. Fan does not start as commanded.
- H. Operator Workstation: Display the following data in addition to all points listed above:
1. Room/area served.
 2. Room occupied/unoccupied.
 3. Room temperature.
 4. Local temperature adjustment.
 5. Room temperature set point, occupied.
 6. Room temperature set point, unoccupied.
 7. Fan status.
 8. Air-damper position as percent open.
 9. Electric Heating Coil Modulation.
 10. Alarms.

1.5 TERMINAL UNIT OPERATING SEQUENCE

- A. Cabinet Unit Heater and Unit Heaters, Electric:
1. Room Temperature:
 - a. Input Device: Room thermostat.
 - b. Output Device: Room thermostat.
 - c. Action: Cycle fan to maintain temperature.
 2. Low-Temperature Safety:
 - a. Input Device: Line-voltage, on-off thermostat, pipe mounted.
 - b. Output Device: Hard wired.
 - c. Action: Stop fan when heating temperature falls below 35 deg F

3. Display:
 - a. Room temperature indication.
 - b. Room temperature set point.
 - B. Radiant Ceiling Panels, Electric: Space Temperature Sensor. If radiant ceiling panel is installed in space with cooling, lock out radiant heating until system is in heating mode. During occupied and unoccupied times, radiant panels to be first stage of heating to maintain room set point. Interlock with FPB and system operation.
 1. Minimum Points List:
 - a. (AI) Space temperature.
 - b. (AI) Local temperature adjustment.
 - c. (AO) Electric heating coil.
 - d. (DO) Coil status (enable/disable).
 - e. (DI) Occupancy override.
 2. Display:
 - a. All points.
- 1.6 EXHAUST FANS
- A. Exhaust Fans: Control through pilot light switch to cycle fan on/off. Exhaust fans shall be enabled on time of day schedule. See exhaust fan schedule.
 1. Minimum Points List:
 - a. (DO) Fan Control (enable/disable).
 - b. (DI) Fan Status (current sensor).
 - c. (AI) Space Temperature.
 2. Signal alarm for the following conditions:
 - a. Fan does not start as commanded.
 - b. Space temperature exceeds setpoint by 5 degrees F. for a period of 15 minutes.
 3. Operator Workstation: Display the following data in addition to all points listed above:
 - a. Room/area served.
 - b. Fan status.
 - c. Alarms.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and flat-oval ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.
- B. Related Sections:
 - 1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Sections for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts and thermoplastic ducts.
 - 3. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated 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 loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.

- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Diffusers, grilles, registers, louvers, etc. locations including sizes, air quantity and system.
 - 5. Reflected ceiling plan including all devices, equipment, etc. installed in ceiling by other trades.
 - 6. Elevation of top of ducts.
 - 7. Dimensions of main duct runs from building grid lines.
 - 8. Fittings.
 - 9. Reinforcement and spacing.
 - 10. Seam and joint construction.
 - 11. Penetrations through fire-rated and other partitions.
 - 12. Equipment installation based on equipment being used on Project.
 - 13. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 14. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
 - g. Other devices installed in ceiling.
- B. Welding certificates.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 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 2-1, "Rectangular Duct/Transverse 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 2-2, "Rectangular Duct/Longitudinal Seams," 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 4, "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."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL 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.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse 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."
 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," 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."
 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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."

2.3 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. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless Steel Sheet: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed

surface finish shall be No.2B, No. 2D, No. 3 or No. 4 as indicated in the "Duct Schedule" Article.

- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 3. 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.
 - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive 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."
- B. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick aluminum or stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
 10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 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.
- B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 11. Sealant 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."
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Base: Synthetic rubber resin.
 3. Solvent: Toluene and heptane.
 4. Solids Content: Minimum 60 percent.
 5. Shore A Hardness: Minimum 60.
 6. Water resistant.
 7. Mold and mildew resistant.
 8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 9. VOC: Maximum 395 g/L.
 10. Sealant 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."
 11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 12. Service: Indoor or outdoor.
 13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- E. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealant 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."
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 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 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "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

3.1 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. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 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.

3.3 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."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor Exhaust Ducts: Seal Class C.
 - 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 4. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 5. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 6. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 7. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 8. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 9. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 10. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "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 thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches 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 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches 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.
- 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.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in "Exterior Painting" and "Interior Painting."
- B. Paint exterior of metal ducts as indicated on plans. Color to be as selected by the Architect. Paint materials and application requirements as specified.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.8 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.

3.9 START UP

- A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. All supply, return and exhaust ductwork within pool building and within a corrosive environment to be aluminum construction.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - 2. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
 - 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 4-inch wg.
 - 4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 3-inch wg.

- C. Return Ducts:
 - 1. Ducts Connected to Fan Coil Units, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
- D. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - 1. Ducts Connected to Fan Coil Units, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
- F. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
 - 2. Stainless Steel Ducts
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 3. Aluminum Ducts: Aluminum.
- G. Liner:
 - 1. Low Pressure Supply Air Ducts: Fibrous glass, Type I, 1 inch thick. (Low pressure ducts and ductwork downstream of terminal units.)
 - 2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
 - 3. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick. (Liner to not be installed in areas of high humidity exhaust.)
 - 4. Transfer Ducts: Fibrous glass, Type I, thick.
- H. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 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 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

- c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 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 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- I. Branch Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - 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 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Backdraft dampers.
 - 2. Manual volume dampers.
 - 3. Fire dampers.
 - 4. Flange connectors.
 - 5. Turning vanes.
 - 6. Remote damper operators.
 - 7. Duct-mounted access doors.
 - 8. Flexible connectors.
 - 9. Flexible ducts.
 - 10. Duct accessory hardware.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installation.
 - d. Fire-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- 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 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.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Exhaust Fan Manufacturer.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 3000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.063-inch-thick extruded aluminum, with welded corners and mounting flange.

- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Aluminum.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. 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 minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 6. Screen Mounting: Rear mounted.
 - 7. Screen Material: Aluminum.
 - 8. Screen Type: Bird.
 - 9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. Nailor Industries Inc.
 - f. Ruskin Company.
 - g. Vent Products Company, Inc.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
 - 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-steel, 0.064 inch thick.
 - 6. Blade Axles: Galvanized steel.

7. Tie Bars and Brackets: Galvanized steel.

2.5 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Air Balance Inc.; a division of Mestek, Inc.
 2. Nailor Industries Inc.
 3. Ruskin Company.
 4. Vent Products Company, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
 1. Use Static Fire Dampers for transfer ducts.
 2. Use Dynamic Fire Dampers for supply, return and exhaust ducts.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 Hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory-installed, galvanized sheet steel.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.6 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.7 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. Elgen Manufacturing.
 4. METALAIRE, Inc.
 5. SEMCO Incorporated.
 6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured 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.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.8 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pottorff; a division of PCI Industries, Inc.
 2. Ventfabrics, Inc.
 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed, 2 inches deep.
- F. Wall-Box Cover-Plate Material: Stainless steel.

2.9 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Flexmaster U.S.A., Inc.
 3. McGill AirFlow LLC.
 4. Nailor Industries Inc.
 5. Pottorff.
 6. Ventfabrics, Inc.
 7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - 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 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 Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Continuous hinge and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Continuous hinge and two compression latches with outside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous hinge and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 4. Factory set at 3.0- to 8.0-inch wg.
 5. Doors close when pressures are within set-point range.
 6. Hinge: Continuous piano.
 7. Latches: Cam.
 8. Seal: Neoprene or foam rubber.
 9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.
- 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 carbon steel, 0.0428-inch stainless steel.
 - D. Fasteners: Carbon or Stainless steel, to match duct material. 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.
 - F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 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. Elgen Manufacturing.
 - 4. Ventfabrics, Inc.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, 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 wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-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..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- 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..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.12 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. Thermaflex.
- B. Noninsulated, Flexible Duct: UL 181, Class 1 Similar to Thermaflex S-TL.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 6000 fpm.
 - 3. Temperature Range: Minus 20 to plus 250 deg F.
 - 4. Fabric: Coated fiberglass woven fabric.
 - 5. Steel Wire: Coated spring steel wire helix.
 - 6. Flame Spread: Not to exceed 25.
 - 7. Smoke Developed: Not to exceed 50.
- C. Insulated, Flexible Duct: UL 181, Class 1, similar to Thermaflex M-KC.
 - 1. Pressure Rating: 10-inch wg positive and 2.0-inch wg negative.
 - 2. Maximum Air Velocity: 6000 fpm.
 - 3. Temperature Range: Minus 20 to plus 250 deg F.
 - 4. Fabric: Coated fiberglass woven fabric.
 - 5. Steel Wire: Coated spring steel wire helix.
 - 6. Flame Spread: Not to exceed 25.

7. Smoke Developed: Not to exceed 50.
8. 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 in sizes 3 through 18 inches, to suit duct size.

2.13 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

3.1 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 dampers at exhaust ducts as close as possible to exhaust louver 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 dampers according to UL listing.
- H. Install silencer according to manufacturer's written installation instructions.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 1. Downstream from manual volume dampers.
 2. Adjacent to and close enough to fire 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.
3. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 4. At each change in direction and at maximum 50-foot spacing.
 5. Upstream from turning vanes.
 6. Control devices requiring inspection.
 7. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
1. Head and Hand Access: 18 by 10 inches.
 2. Head and Shoulders Access: 21 by 14 inches.
- L. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- P. Connect flexible ducts to metal ducts with draw bands.
- Q. Install duct test holes where required for testing and balancing purposes.
- 3.2 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 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.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Centrifugal roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also 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.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 1. Roof framing and support members relative to duct penetrations.
 2. Ceiling suspension assembly members.
 3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Belts: One set for each belt-driven unit.

1.8 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Loren Cook Company.
 - 3. PennBarry.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt Drives:
 - 1. Resiliently mounted to housing.
 - 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 5. Fan and motor isolated from exhaust airstream.
- E. 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 mesh, aluminum or brass wire.
 - 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
 - 2. Overall Height: 18 inches.
 - 3. Sound Curb: Curb with sound-absorbing insulation.
 - 4. Metal Liner: Galvanized steel.
- G. Capacities and Characteristics: See Drawings.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "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.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to 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. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration Controls for HVAC Piping and Equipment."
- C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See "Roof Accessories" for installation of roof curbs.
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 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.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 23 05 93 "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

SECTION 23 36 00

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fan-powered air terminal units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in "Operation and Maintenance Data," include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fan-Powered-Unit Filters: Furnish one spare filter for each filter installed.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 SERIES FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Krueger
 2. Titus.
 3. Tuttle & Bailey.
- B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud for installation above a ceiling.
- C. Casing: 20 gauge galvanized steel, single wall, mechanically assembled.
 1. Casing Lining: Adhesive attached, 3/4-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Lining shall meet UL 181 for erosion.
 2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
 5. Fan: Forward-curved centrifugal.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- E. Velocity Sensors: Multipoint array with velocity sensors in cold- and hot-deck air inlets and air outlets.
- F. Motor:
1. 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."
 2. Type: Electronically commutated motor (ECM).
 3. All ECM motors to include inductors/filter/choke as required to provide the best power factor and least amount of harmonic current possible.
 4. Fan-Motor Assembly Isolation: Rubber isolators.
 5. Enclosure: Totally enclosed, fan cooled.
 6. Efficiency: Premium efficient.
 7. Electrical Characteristics:
 - a. Horsepower: See plans.
 - b. Volts: See plans.
 - c. Phase: See plans.
 - d. Hz: 60.
 - e. Include inductor/choke (6 mH) to minimize harmonic distortion and increase power factor. Utilize choke size as required to provide best performance possible.
- G. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Material: 1 inch, glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.
- H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Location: Plenum air inlet.
 2. Stage(s): SCR Controller.
 3. Access door interlocked disconnect switch.
 4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 5. Nickel chrome 80/20 heating elements.
 6. Airflow switch for proof of airflow.
 7. Fan interlock contacts.
 8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 9. Mercury contactors.
 10. Pneumatic-electric switches and relays.
 11. Magnetic contactor for each step of control (for three-phase coils).

- I. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
 - 1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
 - 2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
 - 3. Disconnect Switch: Factory-mounted, fuse type.
- J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- K. Electronic Controls: Bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
 - 1. Occupied and unoccupied operating mode.
 - 2. Remote reset of airflow or temperature set points.
 - 3. Adjusting and monitoring with portable terminal.
 - 4. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."

2.2 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "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 and for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

3.3 CONNECTIONS

- A. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- B. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Air terminal unit will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

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

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Ceiling diffusers.
 - 2. Registers and grilles.
- B. Related Sections:
 - 1. Division 23 Section "Air Duct Accessories" volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION 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

2.1 DIFFUSERS, REGISTERS AND GRILLES

- A. Tag A:
 - 1. Tag A: Basis-of-Design Product: Subject to compliance with requirements, provide Titus TMSA-AA or comparable product by one of the following:
 - a. Krueger
 - b. Titus.
 - c. Tuttle & Bailey.
 - 2. Material: Aluminum.
 - 3. Finish: As selected by Architect.
 - 4. Face Size: See drawings.
 - 5. Face Style: Three cone.
 - 6. Mounting: See drawings.
 - 7. Pattern: Adjustable.
 - 8. Dampers: Combination damper and grid.

9. Accessories:
 - a. Equalizing grid.
 - b. Sectorizing baffles.
- B. Tag B:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Titus 4FL or comparable product by one of the following:
 - a. Krueger
 - b. Titus.
 - c. Tuttle & Bailey.
 2. Material: Aluminum.
 3. Finish: As selected by Architect.
 4. Face Arrangement: 1/2-spacing 45 degree angle
 5. Core Construction: Integral
- C. Tag C:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Titus TBDI-80 with insulated plenum slot diffuser or comparable product by one of the following:
 - a. Krueger
 - b. Titus.
 - c. Tuttle & Bailey.
 2. Devices shall be specifically designed for variable-air-volume flows.
 3. Material - Shell: Aluminum.
 4. Material - Pattern Controller and Tees: Aluminum.
 5. Finish - Face and Shell: As selected by architect.
 6. Finish - Pattern Controller: Black.
 7. Finish - Tees: As selected by architect.
 8. Slot Width: 1.0 inches.
 9. Number of Slots: Two.
 10. Length: 4 foot.
 11. Accessories: Coordinate mounting with ceiling.
 12. Plenum: 4-foot lined insulation.
- D. Tag D:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Titus 300 FL or comparable product by one of the following:
 - a. Krueger
 - b. Titus.
 - c. Tuttle & Bailey.
 2. Supply Register.
 3. Material: Aluminum.
 4. Finish: As selected by architect.
 5. Face Style: Adjustable double deflection.
 6. Mounting: See drawings.
 7. Dampers: Opposed blade damper.
- E. Tag E:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Titus 350FL or comparable product by one of the following:
 - a. Krueger
 - b. Titus.
 - c. Tuttle & Bailey.

2. Material: Aluminum.
3. Finish: As selected by Architect.
4. Face Arrangement: 3/4-spacing 35 degree angle
5. Core Construction: Integral

2.2 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

3.1 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.

3.2 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.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 82 39.19

WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include details of anchorages and attachments to structure and to supported equipment.
 - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Wiring Diagrams: Power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Marker Products.
 - 2. QMark Electric Heating.

2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

- A. Front Panel: Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

- A. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

2.7 CAPACITIES AND CHARACTERISTICS: SEE PLANS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION

SECTION 26 00 00

ELECTRICAL, GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. General provisions of contract include the following: Bidding requirements, contract forms, provisions of contract, and Division 1. These provisions contain requirements which affect electrical work under Divisions 26, 27 and 28 and which must be complied with as a part of the work.
- B. Divisions 26, 27 and 28 are subdivided into various sections for general convenience.
- C. Provide items, articles, materials, operations and methods required by drawings and specifications including labor, equipment, supplies and incidentals necessary for completion of work in Divisions 26, 27 and 28.
- D. It is the intention of Divisions 26, 27 and 28 specifications and drawings to call for finished work, tested and ready for operation.
- E. Apparatus, appliance, material or work not shown on the contract drawings, but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and ready for operation, even though not specified or shown on the contract drawings, shall be furnished and installed without additional expense to Owner.
- F. Should there be any discrepancies or a question of intent, refer the matter to the architect for a decision before ordering any equipment or materials or before starting any related work.

1.2 WORK INCLUDED

- A. Electrical work is indicated on drawings and includes but is not limited to the following:
 - 1. Demolition and remodeling.
 - 2. Feeder and branch circuit wire and conduit.
 - 3. Lighting fixtures and lamps.
 - 4. Wiring devices such as boxes, switches, receptacles, etc.
 - 5. Conduit fittings, supports, etc., though not shown.
 - 6. Panel boards and other service equipment or materials.
 - 7. ARC Flash and Fault Current Coordination Study.
 - 8. Circuit breakers, motor starters, safety switches, fuses and other over current protection and safety devices.
 - 9. All devices, starters, disconnect switches, etc. serving three-phase motors shall have phase protection to protect motors from single-phasing.
 - 10. Fire alarm system.
 - 11. Inspection of Existing Systems

- B. Contractor shall provide all temporary services required to maintain normal building operation during construction. Temporary interruption of services shall occur during non-school hours. Contractor shall be solely responsible for determining construction sequencing and shall include all costs required for maintaining all mechanical, plumbing, and electrical services to entire facility during school year.
- C. Mechanical, plumbing, and electrical equipment/systems shall not be taken out of service or demolished until end of the school year. Contractor shall include all costs associated for maintaining systems fully operational until end of school year.

1.3 WORK NOT INCLUDED

- A. Unless otherwise stated, power wiring for all mechanical equipment is the responsibility of the electrical contractor with control wiring the responsibility of the mechanical contractor. This statement is not meant to preclude a different distribution of responsibility by the general contractor, who is responsible for a complete installation through interaction of subcontractors. Wiring (120 volt) between exhaust fan and powered damper and/or line voltage thermostats is by electrical contractor.

1.4 QUALITY ASSURANCE

- A. Each major component of equipment shall have the manufacturer's name, address, model number and ratings on a plate securely affixed in a conspicuous place.
- B. Code ratings, labels or other data which are die-stamped or otherwise affixed to the surface of the equipment, shall be in label of Underwriter's Laboratories, Inc. (UL). Approval must be obtained for materials furnished as equals. All proposals shall be prepared on the basis of using exactly the materials and items specified. If the contractor wishes to have other items considered, he must submit these items with his proposal and state the amount to be added or deducted.

1.5 ABBREVIATION

- A. Reference to a technical society, institution, association, or governmental authority is made in these specifications in accordance with the following abbreviations. All groups listed below do not necessarily apply to this project and are listed for informational purposes only:
 1. ASE: Association of Safety Engineers
 2. ASME: American Society of Mechanical Engineers
 3. EPA: Environmental Protection Agency
 4. IEEE: Institute of Electrical and Electronics Engineers
 5. MCAA: Mechanical Contractor's Association of America
 6. NEMA: National Electrical Manufacturers Association
 7. NEC: National Electrical Code 2014
 8. NFPA: National Fire Protection Agency
 9. ADA: Americans with Disabilities Act
 10. IBC: International Building Code 2015

11. IFC: International Fire Code 2015
12. IECC: International Energy Conservation Code 2018
13. IAC: Illinois Accessibility Code
14. City of DesPlaines Code and Local Amendments.

1.6 SUBMITTALS

- A. As-built drawings: The contractor shall keep continuous, up-to-date records of all deviations and changes between the work as shown on the drawings and as actually installed. Upon completion of the work and as a condition prior to final acceptance and payment, he shall furnish directly to the Owner the project record data. The accuracy of this data shall be the responsibility of the contractor, who shall bear all expenses for any required corrections. As-builts shall be furnished on reproducible heavy bond paper and electronically in PDF and Revit format (version selected by Architect). Obtain signed certification from an authorized Owner's representative. All devices turned over without a signature and later lost, will be replaced at the contractors expense. Provide three (3) sets of as-built information including electronic version on flash drive.

1.7 INSPECTION OF EXISTING SYSTEMS

- A. The contractor will be responsible for inspecting all existing systems that will be worked on (during the course of the construction project) before touching them. This shall cover, but not limited to the following systems: electrical service, fire alarm system, intrusion/access control/security camera systems, local area network system, phone system, intercom/clock, etc.). This inspection will need to document any issues with the existing systems that are affecting their proper operation. If this report is not provided, the contractor is attesting that all systems were functional and properly operating before the start of the construction and will be responsible for all repairs. The onus is on the contractor to identify problems with any of the systems to the Owner prior to construction.

1.8 JOB REQUIREMENTS

- A. The contractor shall keep himself informed as to the progress of the work and shall keep a sufficient force of workmen on the job so as not to delay the progress of the work.
- B. The contractor shall be responsible for the exact location of all devices, and shall be responsible for all cutting and patching. No cutting shall be done without approval.
- C. The Owner reserves the right to change the position of devices before the work is installed without extra charge. The contractor shall be responsible for determining exact locations in the field. In this sense the drawings are diagrammatic.
- D. The contractor shall obtain all the necessary measurements in order that his work may fit all parts of the work. He shall further verify all the necessary measurements at the building in order that his work may fit that already in place.

1.9 CODE REQUIREMENTS AND INSPECTION AUTHORITIES

- A. All work shall be installed according to the rules and regulations of the National Electrical Code, IBC, the Occupational Safety and Health Act, IAC and ADA regulations, and the local inspection authorities. This shall include all written provisions and amendments to the electrical code and all interpretive provisions and directives of the chief electrical inspector, which may be in effect or enacted and in force until the final acceptance of the work.
- B. The quality and type of work referred to above shall be regarded as the minimum requirements, and shall be exceeded where required by this specification.
- C. The contractor shall study the drawings and specifications prior to submitting his proposal and, if inspection authorities or labor conditions require work in addition to that specified or shown, the contractor shall state in his proposal the items involved and the additional amounts required for such items. After entering into a contract, the contractor agrees that all such items are included in his proposal and will not be cause for additional charges to the Owner.

1.10 DRAWINGS

- A. The small scale of the drawings does not permit duplication of all panels, feeders, junction boxes and other equipment on all sheets. Drawings are, in essence, diagrammatic and it is the contractor's responsibility to install a complete working system. Special care shall be exercised in the installation of the work to include all material and fittings necessary for a complete installation. Exact dimensions and locations of all outlets shall be verified on-the-job. Before preparing his proposal the contractor shall examine all architectural drawings and engineering drawings. If any discrepancies or details of the construction interfere with the work, he shall report the same and obtain written instructions as to the changes necessary. Should he neglect to do so, he shall make the necessary changes at his own expense. Modifications of drawings are permissible as long as coordinated with Engineer/Architect and allowed by Owner.
- B. The drawings show only the general routing of the conduit. The scale of the drawing does not permit the indication of all junction boxes, pull boxes, and fittings that may be required. The cost of such work shall be considered as part of the contract and extra payment will not be made for such work.
- C. Contractor shall refer to plans for the location of light fixtures, fire alarm devices, wiring connections to kitchen equipment, etc.

1.11 COOPERATION AND COORDINATION

- A. The contractor shall confer with other trades at the site, before installing his work, to avoid interferences so that maximum headroom and clearances may be maintained. In the event that interferences develop between work of various trades, the architect's decision will be final and additional compensation will not be allowed for moving of misplaced work.

- B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- C. 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.
- D. Coordinate any electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of any exterior underground utilities and services, including provision for electricity-metering components.
- E. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- F. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- G. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- H. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.
- I. Particular attention shall be paid to situations where recessed equipment, pipes and lights occur, or where work of several trades occurs together above suspended ceilings, in pipe shafts or in areas where space is limited.
- J. All fixtures, equipment, devices, switches and outlets shall be positioned to avoid all interferences with and to assure proper coordination with work of all other trades, cases, partitions, wall, floor and ceiling patterns, architectural features, etc. All recessed devices, fixtures, etc. shall be coordinated to work out conflicts and adjustments where such adjustments are warranted.
- K. Contractor shall furnish and install all VFC's motor starters and disconnect switches for mechanical equipment installed under Division 23 unless specifically called out for in mechanical contractor's scope of work. Coordinate VFC's starter and disconnect sizes with Division 23 contractor(s) before ordering and installing. Refer to mechanical and plumbing drawings. All 3-phase starters shall be furnished with phase loss/under-voltage protection.
- L. The contractor shall provide and install junction box and conduit stubbed up above ceiling for mechanical contractor's thermostat and all other associated sleeves to accommodate thermostat cabling. Mount at 56-1/2" to center. Refer to mechanical drawings and coordinate with temperature control contractor for all thermostat locations.

1.12 TEST REQUIRED

- A. Any wiring devices, lighting fixtures or electrical apparatus in the contract, if grounded or shorted, shall be corrected or replaced at the contractor's expense.

1.13 DEFECTIVE WORK AND MATERIAL

- A. All material or work found to be defective or not in strict conformity with drawings or different from requirements of drawings and specifications or defaced or injured through negligence of the contractor or his employees, through damage in shipments, or through action of fire or weather will be rejected and shall be immediately removed from premises by the contractor and satisfactory material and work substituted without delay.
- B. Any defective work or imperfect work shall be corrected immediately on notice from the architect. No previous inspection or certificate on account shall be held to relieve the contractor from his obligation to furnish sound material and to perform good and satisfactory work.

1.14 CUTTING, DRILLING, PATCHING AND PAINTING

- A. All cutting, drilling, patching and painting of wood construction, masonry, steel or iron work belonging to the building shall be done by the contractor in order that his work may be properly installed, and all disturbed construction or finish must be made good, but under no conditions must structural work be cut except upon approval by the architect.
- B. Cutting, patching and painting for electrical work shall be performed by this contractor unless noted otherwise. This contractor shall coordinate his work with the other trades for completing the work satisfactorily. Contractor is responsible for refinishing areas cut or patched by the execution of this work so as to match existing surrounding area. Trimmed cuts will be acceptable when approved by the architect.
- C. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- D. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

1.15 DEMOLITION AND REMODELING

- A. Work included:
 - 1. The work involved includes modifications, additions, and deletions to an existing electrical system. Contractor shall furnish all labor, equipment, supplies and incidentals necessary to alter the existing system to produce the desired result shown on the drawing and specified in the project manual.

2. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
- B. Existing conditions:
1. Building plans shown are compiled from sources believed to be accurate. However, the information shown on these plans is conceptual and the contractor shall be responsible for field verification of all dimensions, sizes, system voltages, quantities and extent of work. The contractor shall carefully examine the premises in order familiarize himself with existing conditions and fully understand the nature and scope of work.
 2. Drawings are strictly schematic and a complete coordinated, functional and code approved system is intended.
- C. Electrical demolition work shall include removal of all equipment, fixtures, piping, wire, receptacles and other electrical equipment and materials as shown on the drawings or necessary for the modification shown. Disconnect and remove all power wiring to mechanical equipment being removed.
1. Contractor shall bear all expenses for legally disposing of all light fixtures and their related ballasts, lamps and battery packs. Follow all EPA (Environmental Protection agency) guidelines and submit proper paperwork with certification of above.
- D. Materials:
1. Requirements for equipment, supplies, and accessories that are to be added to the electrical system are specified in other sections.
 2. Materials shall be new unless otherwise indicated. When so indicated existing equipment, supplies and accessories may be reused (sometimes relocated). Contractor must verify that existing materials are sound and fully functional for the design intended. Maintaining the condition of relocated materials is the responsibility of the contractor.
- E. Conduit and wire:
1. At contractor's option, existing raceway may be reused if not removed and meets new application. Existing power wiring for receptacle and lighting circuits may be reused if not removed and meets new application, unless otherwise indicated elsewhere. Wire and cable that has been removed shall not be reinstalled. Raceway that is in like-new condition may be reused if not removed. Raceway and power wiring that is being reused shall be tested for continuity of conduction and ground for insulation resistance of conductor and splices. Contractor shall remove and replace all wiring which is defective at contractor's expense.
- F. Existing service:
1. Existing building services shall be maintained and temporary services shall be provided when required at the contractor's expense. In the event that a shutdown cannot be avoided, the service interruption shall be with the minimum inconvenience to the occupants and with the approval of and under the supervision of the architect. In no case will the contractor interrupt service without the permission of the Owner or architect.
 2. Existing Building Systems: Contractor shall provide all temporary services required to maintain all building systems in working order during

construction. Temporary interruption of building systems shall only occur during non-school hours. Contractor shall be solely responsible for determining construction sequencing and shall include all costs required for maintaining all mechanical, plumbing, and electrical systems throughout the entire facility during operational hours.

- G. Revisions to the building:
1. Refer to the architectural drawings and details for exact locations of existing partitions to be remodeled, existing partitions to remain and new partitions. This contractor shall repair all damages to existing construction due to his demolition operation or installation of new work.
- H. Abandoned equipment and materials:
1. Switches and outlets: When noted on drawings, the contractor shall abandon switches and outlets by removing them and providing solid cover plates. Electrical service to these devices shall be disconnected and/or spliced for resumption of service to devices not removed. Paint cover plate to match surrounding area. If box is prefinished material, install stainless steel cover plate.
 2. Raceways and wire: Cut and removed buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- I. Installation:
1. Remove electrical equipment and installations, indicated to be demolished.
 2. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the work, remove damaged portions and install new products of equal capacity, quality, and functionality.
 3. All materials, such as light fixtures, that are to be removed, are the property of the Owner. Contractor shall store material as directed by the Owner, or at Owner's direction, the contractor shall assume responsibility for legal disposal per EPA requirements.
 4. When removal of existing materials causes voids in existing cover plates or uncovered junction boxes, etc., provide solid finished covers that protect the void or opening and match surrounding area as closely as possible.
 5. Remove demolished material from project site. Coordinate with drawing for disposal of removed materials.
 6. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
 7. All raceways and conduit shall be run concealed. Fish through existing walls and ceilings as required. In the event concealed conduit is impossible, surface mounted metallic raceways shall be used with the approval of the architect. Surface mounted conduit shall also be used when specifically designated on the drawings in locations where exposed conduit is the predominant wiring method currently in use. Contractor may modify or add to that system with exposed conduit necessary to achieve design results. Exposed conduit in finished areas shall not be installed unless approved by the architect. Conduit installation shall be

accomplished in a neat workmanlike manner. Run tight to walls at ceiling edge. Coordinate final routings in the field with the architect prior to installation. All exposed conduits shall be painted to match surrounding area.

8. Existing lay in ceiling tiles shall be removed and reinstalled as required for the installation of new electrical work. Tiles damaged by this work shall be replaced with identical materials at the contractor's expense.
9. Where the work of one trade will interfere with the work of other trades, all trades shall assist in working out space conditions, make satisfactory adjustments and shall be prepared to submit and revise coordinated shop drawings.
10. With the approval of the architect/engineer and without additional cost to the Owner, make minor modifications in the work, including rerouting as required by interferences with structural general and work of other trades or for the proper execution of the work.
11. Work installed before coordinating with other trades so as to cause interference with their work shall be reworked, without additional cost to the Owner, as directed by the architect. The contractors shall make all necessary provisions to pursue their work in a manner which will assure that the operation of the building is minimally impaired. This shall include, but not be limited to, delivery of supplies, temporary utility connections, etc. Storage of materials must be at locations approved by the Owner.
12. Circuits shown to the panels for load and wiring are diagrammatic. The contractor shall have the option on conduit fill and runs in accordance with local municipal code for rewiring on the revision portion and standard conduit fill for new work. Final decisions for revision and connection to the new and existing system will have to be made in the field. Circuits shall be picked up overhead or through the floor to existing and new panels. Verify in the field.

1.16 CHASES AND OPENINGS

- A. Provide to masonry or concrete trades, templates or details for chases and openings to be left in floors, walls and partitions to accommodate work for each trade.

1.17 CLEANING UP

- A. After the completion of the electrical installation, the entire system shall be thoroughly cleaned. Clean all foreign matter from all fixtures, equipment, and exterior of conduits. Remove all rubbish, debris, etc. accumulated from this operation during the course of the work and at the completion of the project. Legally dispose of same off-the-site.

1.18 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements as specified.
 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.

2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

1.19 FIRE-STOPS

- A. Penetrations through fire rated walls and floors shall be sealed to the original hourly fire rating with a fire-stop system capable of preventing the passage of flames and hot gases when subject to the requirements of the test standards specific for Fire-Stops ASTM E119 and E814 (UL 1479). Utilize 3M, General Electric, Metalines Inc., Nelson Electric or Hilti products. The fire stop system installation must meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

1.20 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified.
- B. Concrete: 3000-psi, 28-day compressive strength as specified.
- C. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

1.21 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

1.22 SUBSTANTIAL AND FINAL COMPLETION

- A. The contractor shall provide written notification to the engineer that the project is substantially complete. The engineer will accomplish a substantial completion inspection and provide the contractor with a list of work requiring corrective action. Upon completion of the corrective work, the contractor shall provide written notice that all corrective work has been completed. The engineer will conduct an inspection of the corrective work. The contractor shall bear costs of correcting such work, including additional testing and inspections, and compensation for the engineer's services and expenses made necessary thereby.
- B. One final inspection will be conducted for completion of work after written notification from the contractor. Additional inspections will be conducted at the expense of the contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. See subsequent sections of the electrical division of these specifications for information.

2.2 GUARANTEE

- A. Electrical work shall be guaranteed for both materials and labor for a period of (1) one year in accordance with the general conditions and Division 1.
- B. Manufacturer's equipment guarantees or warranties for periods of more than one year shall be included in the maintenance manuals.

PART 3 - EXECUTION

3.1 PREPARATION/INSTALLATION/APPLICATION

- A. Adapt the work to the job conditions and make such changes as required and authorized by the architect, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, raising or lowering conduits, outlets and fixtures to permit the proper installation of other mechanical or electrical equipment.
- B. All work shall be performed by trained mechanics of the particular trade involved in a neat and workmanlike manner as approved by the architect.

3.2 PROTECTION

- A. Protect the materials and work of other trades from damage during installation of the work provided under Divisions 26, 27 and 28.
- B. Pay particular attention to the limited space available in certain locations of the project so that equipment may be installed without any interference.
- C. In all rooms with exposed or concealed ductwork or piping, the exact locations of lighting fixtures shall be coordinated so as to clear all ducts and piping and obtain uniform light distribution.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 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.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products 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.

2.3 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.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounted 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.

3.2 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 all penetrations. 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. If above accessible ceiling, sleeves can extend 1 inch out of wall.
- F. Extend sleeves installed in floors 2 inches above finished floor level or to above ceiling when concealing low voltage cabling of any type.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway. All other sleeves for cabling shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required.
- 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.
- 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.
- 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.
- N. Furnish and install sleeves for all low voltage cabling, including Data, Voice, Video, Intercom/Paging, Clock, Thermostat, Fire Alarm, Security, etc. All sleeves shall be provided with end bushing/fitting to protect cabling. Sleeves shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required.

Minimum sleeve size is 3/4 inch conduit unless noted elsewhere. Use minimum of 1-1/4 inch conduit for data/voice cabling.

3.3 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.

3.4 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 as specified.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V.
 - 2. Connectors, splices, and terminations rated 600 V.
 - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
 - 1. Division 26 Section "Identification for Electrical Systems."

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- 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.
- D. All devices and wiring shall be U.L. listed.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

1.7 WARRANTY

- A. Provide a one year warranty on all parts and labor.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Corp.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. Belden.
 - 4. Carol Cable Co.
 - 5. Essex.
 - 6. General Cable Corporation.
 - 7. Senator Wire & Cable Company.
 - 8. Southwire Company.
 - 9. U.S. Wire & Cable.
- B. Copper Conductors: Comply with NEMA WC 70, 98 percent conductivity.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN/THWN-2, 75 deg C wet/90 deg C dry, XHHW-2, 90 deg C wet/dry and SO, minimum 600 V.

2.2 CONNECTORS AND SPLICES AND TERMINAL BLOCKS

- A. Manufacturers (for Connectors): Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. AMP Incorporated/Tyco International.
 - 3. Buchanan/Tyco.
 - 4. FCI-Burndy.
 - 5. Hubbell Power Systems, Inc.
 - 6. Ideal Industries, Inc.
 - 7. O-Z/Gedney; EGS Electrical Group LLC.
 - 8. 3M; Electrical Products Division.
 - 9. Thomas & Beits Corp.
 - 10. Tyco Electronics Corp.
- B. Manufacturers (for Terminal Blocks): Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy Products/FCI.
 - 2. General Electric Co.
 - 3. IlSCO.
 - 4. Pass & Seymour.

5. Polaris.
 6. Square D Co.
 7. 3M Company.
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
1. Bolted or screwed mechanical pressure/connector block type (insulated).
 2. Compression/crimped pressure type.
 3. Twist-on pressure type plastic or nylon insulator cap with internal threaded core and spring insert.
- D. Terminal blocks: NEMA ICS4; modular, channel (rail) mounted with end-stops; solderless, box/clamp type terminals; 300 volt rated for control conductors, 600 volt rated for power conductors; wire size (cross-section) rated for applicable conductors; suitable for connection of copper conductors; with marking strips.
- 2.3 SLEEVES FOR CABLES
- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
 - B. Coordinate sleeve selection and application with selection and application of firestopping specified.
 - C. Coordinate with Section 26 05 00 "Common Work Results for Electrical" for additional requirements.
- 2.4 SLEEVE SEALS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
 - B. 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.

PART 3 - EXECUTION

- 3.1 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS
- A. Service Entrance: Type XHHW-2, single conductors in raceway.
 - B. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
 - C. Feeders Concealed below Slabs-on-Grade, and in Crawlspace: Type THWN-2, single conductors in raceway.
 - D. Exposed Branch Circuits, including in Crawlspace: Type THWN-2, single conductors in raceway.
 - E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
 - F. Branch Circuits Concealed below Slabs-on-Grade: Type THWN-2, single conductors in raceway.
 - G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
 - H. Fire Alarm Circuits: Refer to drawings for requirements.
 - I. Remote Control and Signal Cable:
 - 1. Control cable for Class I remote control and Signal circuits: Copper conductor, 600 volt THHN/THWN-2 insulation, rated 60 deg C, installed in raceway.
 - 2. Control cable for Class 2 or Class 3 remote control and Signal circuits: Copper conductor, 300 volt insulation, rated 60 deg C, individual conductors twisted together, shielded and covered with a PVC jacket; UL listed. Use plenum rated cable in plenum environments.
 - 3. Plenum cable for Class 2 or Class 3 remote control and Signal circuits: Copper conductor, 300 volt insulation, rated 60 deg C, individual conductors twisted together, shielded and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts and plenums.
 - 4. Coordinate open cabling requirements with local jurisdiction prior to bidding.
 - J. Connections to removal light fixtures in grid ceilings: FMC with THHN/THWN-2, maximum length 6'-0" whips, with ground wire. Provide plenum rated raceways when required by local codes.
 - K. Utilize type THWN-2 for underground feeders or branch circuits subject to becoming wet.
- 3.2 INSTALLATION OF CONDUCTORS AND CABLES
- A. Install copper conductors:
 - 1. Install minimum #12 AWG conductors, except install minimum #14 AWG conductors for control circuits.

2. Install stranded conductors for #10 AWG and larger, and solid or stranded conductors for #12 AWG. Use solid conductors for #14 AWG and smaller.
 3. Use #10 AWG conductor for 20 ampere, 120 Volt branch circuit home runs longer than 75 feet and 277volt circuits longer than 200 feet.
- B. Install a separate dedicated neutral conductor for each phase of both lighting and power multi-wire branch circuits. If a multi-wire branch circuit contains three phase wires, the circuit will require three dedicated neutrals. The use of multi-pole branch breakers to eliminate neutral conductors is not allowed.
 - C. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
 - D. Completely and thoroughly swab raceway system before installing conductors.
 - E. Provide protection for exposed cables where subject to damage.
 - F. Install all power conductors in raceways. Install low voltage wiring in conduit unless otherwise indicated on drawings.
 - G. 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.
 - H. Use U.L. listed pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
 - I. Pull conductors together where more than one is being installed in conduit. Place an equal number of conductors for each phase of a circuit in same raceway or cable. Make conductor lengths equal for all parallel circuits. Size conductors and raceways per NEC. Derate conductor ampacities per NEC.
 - J. Install control conductors in conduit runs separate from power conductors.
 - K. Install cables in conduits parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
 - L. Support according to Division 26 Section "Hangers and Supports for Electrical Systems," and as noted on drawings, above accessible ceiling; do not rest on ceiling tiles.
 - M. Seal wall/floor penetrations accordingly.
 - N. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.3 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. Thoroughly clean wires before installing lugs and connectors.

- 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. Tape uninsulated connectors with electrical tape to 150 percent of the insulating rating of conductor.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- D. Splice conductors only in accessible pull and junction boxes or outlet boxes. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- E. Install block connectors with insulating covers for copper conductor splices or taps, #8 AWG and larger.
- F. Install compression/crimped connectors for copper conductor control circuits terminal.
- G. Install twist-on connectors for copper conductor splices, #10 AWG and smaller, except install terminal blocks for connectors in pull and junction boxes containing 20 or more splices.
- H. Terminate spare conductors with electrical tape.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified.
- B. Coordinate with Section 26 05 00 "Common Work Results for Electrical" for additional requirements.
- C. Concrete Slabs and Walls: Install sleeves for all penetrations. Install sleeves during erection of slabs and walls.
- 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 wall surfaces. If above accessible ceiling, sleeves can extend 1 inch out of wall.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed. All other sleeves for cabling shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required.
- H. Seal space outside of sleeves (both sides of wall) with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint.

- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials.
- K. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves 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 "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.
- N. Furnish and install sleeves for all low voltage cabling, including Data, Voice, Video, Intercom, Clock, Thermostat, Fire Alarm, Security, etc. All sleeves shall be provided with end bushing/fitting to protect cabling. Sleeves shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required. Minimum sleeve size is 3/4 inch conduit unless noted elsewhere. Use 1-1/4 inch conduit for data/voice cabling.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual (for physical damage and proper connection) and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Torque test conductor connections and terminations to manufacturer's recommended values.

4. Perform continuity test on power and equipment branch circuit conductors. Verify proper phasing connection.
 5. Megger test all wiring #8 AWG and larger, regardless of voltage.
- D. 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.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 23

CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, apply to this Section.
- B. Section 27 15 00 Communications Horizontal Cabling.

1.2 SUMMARY

- A. Section Includes:
 - 1. RS-232 cabling.
 - 2. RS-485 cabling.
 - 3. Low-voltage control cabling.
 - 4. Control-circuit conductors.
 - 5. Identification products.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of galvanized steel wire mesh bottom and side rails.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - 1. Vertical and horizontal offsets and transitions.
 - 2. Clearances for access above and to side of cable trays.
 - 3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

4. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 - C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
 - D. Source quality-control reports.
 - E. Field quality-control reports.
 - F. Maintenance Data: For wire and cable to include in maintenance manuals.
- 1.5 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Member company of an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
 - B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
 - C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Test cables upon receipt at Project site.
 1. Test each cable for open and short circuits.
- 1.7 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install UTP and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 1.8 WARRANTY
- A. Provide a (1) one year warranty on all parts and labor.

PART 2 - PRODUCTS

- 2.1 PATHWAYS
- A. Support of Open Cabling: U.L. labeled for support of low voltage cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 2. Lacing bars, spools, J-hooks, and D-rings.

3. Straps and other devices.
4. Cable trays.

- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 inch sized. Comply with requirements for plywood backing panels.

2.3 RS-232 CABLE

- A. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. Fluorinated ethylene propylene jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
 6. Flame Resistance: Comply with NFPA 262.

2.4 RS-485 CABLE

- A. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Overall shielded.
 4. Fluorinated ethylene propylene jacket.
 5. Flame Resistance: NFPA 262, Flame Test.

2.5 LOW-VOLTAGE CONTROL CABLE

- A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Fluorinated ethylene propylene jacket.
 5. Flame Resistance: Comply with NFPA 262.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Fluorinated ethylene propylene jacket.

5. Flame Resistance: NFPA 262, Flame Test.

2.6 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway or power-limited cable, concealed in building finishes, complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.
- D. All cables shall be plenum rated, unless installed in conduit.

2.7 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Brady Corporation.
 2. HellermannTyton.
 3. Kroy LLC.
 4. Panduit Corp.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables according to TIA/EIA-568-C.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with TIA/EIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows if possible.
- E. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard if entering room from overhead.
 4. Extend conduits 3 inches above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards for all wall-mounted electronic equipment. Butt adjacent sheets tightly and form smooth gap-free corners and joints.
- G. Furnish and install sleeves through walls and floors where exposed cabling is allowed. Refer to Division 26 Section 26 05 00 "Common Work Results for Electrical" for additional information.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
1. Comply with TIA/EIA-568-C.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 9. Install end bushing/fittings on all conduit sleeves/stubs to protect cabling.
- C. Installation of Control-Circuit Conductors:
1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
 4. DO NOT route cables above top chord of bar joists and within 6 inches of roof deck to avoid roofing nail damage.
- E. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.
- 3.3 REMOVAL OF CONDUCTORS AND CABLES
- A. Remove abandoned conductors and cables. Re-support any loose cables.
- 3.4 CONTROL-CIRCUIT CONDUCTORS
- A. Minimum Conductor Sizes:
 1. Class 1 remote-control and signal circuits, No 14 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.

3. Class 3 low-energy, remote-control, alarm, and signal circuits, No. 12 AWG.
 - B. Where open cabling is allowed above accessible ceilings it shall be plenum rated.
- 3.5 FIRESTOPPING
- A. Comply with requirements.
 - B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
 - C. Comply with BICSI TDMM, "Firestopping Systems" Article.
- 3.6 GROUNDING
- A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
 - B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."
- 3.7 IDENTIFICATION
- A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- 3.8 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - B. Perform tests and inspections.
 - C. Tests and Inspections:
 1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-C.
 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
- B. Related Sections include the following:
 - 1. Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
 - 3. Grounding devices.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports. Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings and grounding connections for separately derived systems based on NETA MTS and NFPA 70B.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. ANSI/IEEE 32 – Requirements, terms, and test procedures for neutral grounding devices.
- B. ANSI/IEEE C2 – National Electrical Safety Code.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- D. 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.
- E. Comply with UL 467 for grounding and bonding materials and equipment.
- F. Comply with NEC Article 250 and local code requirements.

1.5 WARRANTY

- A. Provide a (1) one year warranty on all parts and labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Apache Grounding/Erico Inc.
 - b. Boggs, Inc.
 - c. Chance/Hubbell.
 - d. Copperweld Corp.
 - e. Erico Inc.; Electrical Products Group.
 - f. Framatome Connectors/Burndy Electrical.
 - g. Harger Lightning Protection, Inc.
 - h. Ideal Industries, Inc.
 - i. ILSCO.
 - j. Kearney/Cooper Power Systems.
 - k. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - l. Raco, Inc.; Division of Hubbell.
 - m. Robbins Lightning, Inc.
 - n. Superior Grounding Systems, Inc.
 - o. Thomas & Betts, Electrical.
 - p. Thompson Lightning Protection.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction, green insulation.
- 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 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 wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- D. Grounding Electrode Conductor: Stranded cable.
- E. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators; mounted on 3/4-inch fire-rated backboard.

2.3 CONNECTORS

- A. Comply with IEEE 837 and UL 467.
- B. 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.
- C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts, or compression type.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid copper conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

- B. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated; mount on 3/4-inch fire-rated backboard.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
- C. 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.
- D. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- E. In raceways, use insulated equipment grounding conductors.
- F. Bond conductors together using thermoweld process.

3.2 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install insulated equipment grounding conductors with all feeders and branch circuits.
- C. 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.
- D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- E. 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.
- F. 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 grounding bus.

2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches 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.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes shall be at least 12 inches 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.
- D. 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.
- E. 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.
 4. Bond mechanical system piping to the building's grounding system, minimum #6 insulated copper ground in conduit.
 5. Bond all metal coolers and freezers to the building's grounding system, minimum #6 insulated copper ground in conduit.

- F. 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.
- G. Fence Grounding (When fencing is noted on drawings):
 - 1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
 - a. Gates and Other Fence Openings: Ground fence on each side of opening.
 - 1) Bond metal gates to gate posts.
 - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
 - 2. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
 - 3. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
 - 4. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- F. Tighten screws and bolts for grounding and bonding 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.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- B. 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.
- C. 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 Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.
 - 4. Pad-Mounted Equipment: 5 ohms.

- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.6 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
 - 3. Requirements when devices are installed in corrosive atmospheres.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.
- D. Corrosive Environment: Any area subject to chlorine, salt water, or other corrosive agent that causes deterioration and fatigue of materials.

1.4 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.
- E. Hot Dipped Galvanized Surfaces: Clean welds, bolted connections, cut and abraded areas and apply zinc rich galvanizing-repair paint to comply with ASTM A 780. Comply with manufacturers recommendations for hot dipped galvanized coating repair.
- F. Duplex Coating Surfaces: Clean welds, bolted connections, cut and abraded areas and apply zinc rich galvanizing-repair paint to comply with ASTM A 780.

Finish with provided paint. Comply with manufacturers recommendations for hot dipped galvanized coating repair.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Special fasteners/devices designed for corrosive type atmospheres.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
 - 5. Special fasteners/devices designed for corrosive type atmospheres.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.
- C. Hot Dipped Galvanized Coating: After fabrication, minimum 3 mil thickness; ASTM A123.
- D. Duplex Coating: After fabrication, consists of a minimum 3 mil thickness, hot dipped galvanized coating; ASTM A123, followed by a painted finish (ASTM D 6386).

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements as specified.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.8 WARRANTY

- A. Provide a (1) one year warranty on all parts and labor.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Power Fasteners.
 - f. Thomas & Betts Corporation.
 - g. Unistrut; Tyco International, Ltd.
 - h. Wesanco, Inc.
 2. Metallic Coatings: Hot-dip galvanized steel after fabrication and applied according to MFMA-4. To be used in all exterior, damp, wet locations.
 3. Nonmetallic Coatings: Manufacturer's standard corrosion-resistant coating with electro-deposition AC04416 coating with rust protection and fade resistant finish, acceptable to authority having jurisdiction. Applied according to MFMA-4.
 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4, unless used in corrosive environment; see Notes 6 and 7 as follows.
 5. Channel Dimensions: Selected for applicable load criteria.
 6. Hot Dipped Galvanized Coating (For Corrosive Environment): After fabrication, minimum 3 mil thickness; ASTM A123.
 7. Duplex Coating (For Corrosive Environment): After fabrication, consists of a minimum 3 mil thickness, hot dipped galvanized coating; ASTM A123, followed by a painted finish (ASTM D 6386).
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. 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.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

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.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
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.
8. Utilize anchoring devices suitable for corrosive environments when identified or encountered.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements for steel shapes and plates.
- C. For corrosive environments, follow Paragraph 2.1, for coating requirements.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter. Maximum spacing for supports shall be 8 feet-0 inches on center and within 3 feet-0 inches of each junction box unless code requires more stringent spacing. Support wireways at intervals not to exceed 5 feet-0 inches.
- 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.

- D. All materials installed in corrosive environments shall follow hot dipped galvanized process and duplex coatings.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70. Requirements must be coordinate with structural engineer prior to installation.
 - 1. Conduit Supports:
 - a. Single run hangers: Conduit straps or clamps.
 - b. Group run hangers: Performed U-channel rack with conduit fittings, provide 25 percent spare capacity.
 - c. Hanger rods: Threaded steel, 1/4 inch diameter minimum.
 - d. Vertical run supports: Preformed U-channel struts with conduit fittings.
 - e. **Perforated straps and spring steel clips and clamps will not be permitted.**
- C. Equipment and Lighting Supports:
 - 1. U-channel: Preformed U-channel struts with fixture and conduit fittings, as applicable.
 - 2. Loose steel angles, channels, plates and tubing.
- D. For exterior roof applications utilize B-line C-port series supporting devices so as not to damage roof system.
- E. 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 25 percent.
- F. 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 thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches 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.

- G. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- H. Install supports, anchors, sleeves and seals to rigidly fastened conduit, wireway and equipment.
- I. Welding supports to building structural members or fastening supports to roof deck or other conduit or pipe will not be permitted.
- J. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- K. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- L. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- M. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- N. Support individual horizontal raceways with separate hangers or clamps.
- O. Fasten hanger rods, conduit clamps, outlets and junction boxes to building structure using beam clamps.
- P. Do not fasten supports to piping, ductwork, mechanical equipment or conduit.
- Q. In wet locations, install free-standing electrical equipment on concrete pads.
- R. Install surface mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall.
- S. Bridge studs top and bottom with channels in support flush mounted cabinets and panelboards in stud walls.
- T. Paint out systems where exposed in finished areas as directed by Architect.
- U. Do not install conduits above top chord of bar joists, in web of roof decking, or within 6" of deck. This is to prevent roofing nails from puncturing conduits.
- V. Support conduits and trapeze hangers from top chord of bar joists. Do not fasten to lower chord of bar joists.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches 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, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements as specified.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Hot Dipped Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780. Comply with manufacturers recommendations for hot dipped galvanized coating repair.
- C. Duplex Coating Surfaces: Clean welds, bolted connections, cut and abraded areas and apply zinc rich galvanizing-repair paint to comply with ASTM A 780. Finish with provided paint. Comply with manufacturers recommendations for hot dipped galvanized coating repair.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for devices installed in boxes.
 - 2. Division 26 Section "Identification for Electrical Systems" for identification requirements and products.
 - 3. Division 26 Section "Hangers and Supports for Electrical Systems."

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. RGS: Rigid galvanized steel.
- G. RNC: Rigid nonmetallic conduit. Not to be used unless strictly specified on drawings.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Coordination Drawings: Conduit routing 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. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- C. Qualification Data: For professional engineer and testing agency.

- D. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: UL 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. UL 870 electrical wireways, auxiliary gutters and associated fittings.
- C. Comply with NFPA 70 and local code requirements for electrical materials and components.
- D. Federal Specifications:
 - 1. W-F406b fittings for cable, power, electrical and conduit, metal flexible.
 - 2. W-F408c fittings for conduit, metal, rigid thick wall and thin wall (EMT) type.
 - 3. WW-C-563A conduit, metal rigid: Electrical thin wall steel type (EMT); straight lengths, elbows and bends.
 - 4. WW-C-566C conduit, metal flexible.
 - 5. WW-C-581E conduit, metal, rigid and intermediate; and coupling, elbow, and nipple, electrical conduit: Steel zinc coated.
 - 6. W-C-582 conduit, raceway, metal and fitting: Surface.
- E. National Electrical Manufacturer Association NEMA:
 - 1. NEMA 250 – 1985 enclose for electrical equipment (1000 V maximum).
- F. American National Standard Institute (ANSI):
 - 1. ANSI C80.1 – Rigid steel conduit zinc coated.
 - 2. ANSI C80.3 – Electrical metallic tubing (EMT), zinc coated.
 - 3. ANSI C80.6 – Intermediate metal conduit (IMC).
 - 4. ANSI/MEMA OS – Sheet steel galvanized boxes, device boxes, covers and box supports.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, 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.

1.7 WARRANTY

- A. Provide a (1) one year warranty on all parts and labor.

PART 2 - PRODUCTS

2.1 METAL CONDUIT, TUBING AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Available metal conduit and tubing manufacturers:

- a. RGS, IMC, and EMT:
 - 1) Allied Tube and Conduit Co.
 - 2) Republic Steel Corp.
 - 3) Triangle PWC, Inc.
 - 4) Wheatland Tube Co.
 - b. FMC:
 - 1) Alflex Corp.
 - 2) American Flexible Conduit Co.
 - 3) Anaconda Metal Hose, Anamet, Inc.
 - 4) Electric Flex Co.
 - 5) Grinnel Co./Tyco International; Allied Tube and Conduit Division.
2. Available metal conduit and tubing fittings manufacturers:
- a. RGS, IMC, EMT, and FMC Fittings:
 - 1) Appleton Electric Co.
 - 2) Cooper/Crouse-Hinds Co.
 - 3) O-Z/Gedney Co.
 - 4) Raco, Inc.
 - 5) Regal Manufacturing Co.
 - 6) IlSCO
 - 7) Allied
 - 8) Wheatland
 - b. Expansion Fittings:
 - 1) Appleton Electric Co.
 - 2) Cooper/Crouse-Hinds Co.
 - 3) O-Z/Gedney Co.
 - 4) Regal Manufacturing Co.
 - 5) Spring City Electrical Manufacturing Co.
 - 6) Thomas & Betts
 - c. Smoke and Fire-Stop Fittings:
 - 1) O-Z/Gedney Co.
 - 2) Spring City Electrical Manufacturing Co.
 - 3) Thunderline Corp.
 - 4) Anixter.
 - d. Sealing and Drainage Fittings:
 - 1) Appleton Electric Co.
 - 2) Cooper/Crouse-Hinds Co.
 - 3) O-Z/Gedney Co.
 - 4) Thomas & Betts
 - 5) 3M
 - e. Wall and Floor Seals:
 - 1) O-Z/Gedney Co.
 - 2) Spring City Electrical Manufacturing Co.
 - 3) Thomas & Betts
 - 4) Appleton
 - 5) Cooper/Crouse-Hinds
 - 6) Anixter.
- B. Aluminum Rigid Conduit: Not allowed, except for special applications when noted on drawings.

- C. Minimum conduit size: 3/4 inch except minimum 1 inch for underground conduit; 1/2 inch conduit will not be allowed unless approved by Owner in writing. Utilize red conduit for fire alarm conduit. Utilize green conduit for all raceways for dedicated grounding conductors. Colored conduits in "WHITE" shall not be used unless treated as a primer coating and then shall be painted out to match area per Architect's direction.
- D. Rigid galvanized steel conduit (RGS) and intermediate metal conduit (IMC): FS WW-C-581; hot dip galvanized; ANSI C80.1, ANSI C80.6 zinc coated, standard threaded conduit couplings.
- E. RGS and IMC fittings: FS W-F-408; hot dip galvanized. Utilize insulated throat connectors/bushings where raceway enters box or other fitting to protect wires, i.e., utilize malleable iron type fittings with molded-on high impact insulation. Include grounding bushing when required. Utilize case hardened lock nuts. **High impact phenolic threaded type bushings are not acceptable.**
- F. Electrical Metallic Tubing (EMT): FS WW-C-563; ANSI C80.3 zinc coated, electro-galvanized. Utilize red conduit for fire alarm conduit.
- G. EMT Fittings: FS W-F-408; electro-galvanized; steel compression type; rain and concrete tight; insulated throat connectors and case hardened locknuts. Set screws not allowed. Utilize insulated throat connectors/bushings where raceway enters box or other fitting to protect wires. Utilize case hardened lock nuts.
- H. Flexible metal conduit (FMC): FS WW-C-566; hot dip galvanized steel.
- I. FMS Fittings: FS W-F-406, Type 1, Class 1, Style A; hot dip galvanized or zinc or cadmium electro-plated; connectors compatible with conduit. Utilize insulated throat connectors/bushings where raceway enters box or other fitting to protect wires. Utilize case hardened lock nuts.
- J. LFMC: Constructed of single strip, flexible continuous, interlocked, and double-wrapped steel; hot dip galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride.
- K. LFMC Fittings: FS W-F-406, Type 1 Class 3, Style G; hot dip galvanized or zinc or cadmium electroplated; connectors compatible with conduit. Utilize insulated throat connectors/bushings where raceway enters box or other fitting to protect wires. Utilize case hardened lock nuts.
- L. Provide plenum rated FMC for all plenum environments required per local codes.
- M. Fittings: NEMA FB 1, compatible with conduit and tubing materials. Utilize insulated throat connectors/bushings where raceway enters box or other fitting to protect wires. Utilize case hardened lock nuts.
- N. 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.
- O. Expansion Fittings: Specifically designed to permit 4 inches linear movement in conduit runs, and to make with adjoining conduit; iron or steel body, hot dip galvanized or zinc electroplated; with bonding jumper.

- P. Sealing and Drainage Fittings: Corrosion resistant case metal body with openings for filling, inspection and drainage; corrosion resistant opening plugs; female hub, top and bottom; specifically designed for sealing vertical runs of conduit to restrict the passage of gases, vapors, and flames and to limit explosions; sealing compound as required and recommended by fitting manufacturer to provide a complete seal.
- Q. Wall and Floor Seals: Factory assembled watertight seals suitable for sealing around conduit passing through concrete foundations, walls and floors; constructed with steel sleeves, iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps and cap screws.
- R. Concrete: As specified.

2.2 NONMETALLIC CONDUIT (ONLY TO BE USED WHEN STRICTLY SPECIFIED ON DRAWINGS)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; a Hubbell Company.
 - 12. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, SCH-80 PVC, unless otherwise indicated.
- C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.\
- D. RNC type conduits will not be allowed inside of building interiors and will be solely used for underground applications. All risers out of ground shall be RGS type conduit.

2.3 Fittings for LFNC: UL 514B

2.4 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
 - 4. Wiremold.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 Indoors, Type 3R Outdoors, unless otherwise indicated.

- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type – NEMA Type 1; flanged-and-gasketed type – NEMA Type 3R
- E. Finish: Manufacturer's standard enamel finish.
- F. Construction: In accordance with UL 870.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
- B. Description: FS W-C-582; sheet metal channel with fitted cover, suitable for use as surface metal raceway.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell.
 - b. Walker Systems, Inc.; Wiremold Company (The).
- C. Surface Nonmetallic Raceways (*Only To Be Used When Indicated on Drawings and Allowed By Authorities Having Jurisdiction*): Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems Division.
 - b. Panduit Corp.
 - c. Walker Systems, Inc.; Wiremold Company (The).
- D. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.
- E. Fittings: Couplings, elbows, and connectors designed for use with raceway system.
- F. Boxes and Extension Rings: Designed for use with raceway systems.
- G. Do not use wiremold raceway on exterior of buildings.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.

10. Spring City Electrical Manufacturing Company.
 11. Thomas & Betts Corporation.
 12. Walker Systems, Inc.; Wiremold Company (The).
 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Provide boxes compatible with conduit and of types, shapes, and sizes including box depths, to suit each respective location.
 - C. Provide box covers of same material as box, unless otherwise indicated, and of types, shapes, and sizes to suit each respective location. Utilize non-magnetic stainless steel brushed satin finish Type 302/304 (0.040 inch thick) in all finished areas.
 - D. Provide box accessories as required for mounting at each respective location including mounting brackets, wallboard hangers, extension rings, fixture studs, clamps, and straps.
 - E. Provide boxes equipped with plaster rings where applicable. Provide access panels in all concealed junction box locations.
 - F. Pull and Junction Boxes: Galvanized sheet steel; NEMA OS 1; welded seams; screw-on covers; equipped with stainless steel nuts, bolts, screws, and washers.
 - G. Interior Outlet Boxes: Galvanized sheet steel; NEMA OS 1; stamped knockouts in back and sides; threaded screw holes with corrosion resistant screws for securing box covers and wiring devices.
 - H. Exterior Outlet Boxes: Corrosion resistant cast metal; NEMA FB 1 threaded conduit ends; weatherproof/gasketed.
 - I. Conduit Bodies (Condulets): Galvanized cast metal; threaded conduit entrance ends; removable covers, corrosion resistant screws.
 - J. Bushings, Knockout Closures and Locknuts: corrosion resistant punched steel box knockout closures and conduit locknuts; 150 deg C plastic bushings.
 - K. Strain Relief Grip: Woven steel mesh with connection fitting, designed to absorb pull, flexure and vibration exerted on cord or cable and prevent disconnection at wired terminals.
 - L. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat flanged, surface mounted junction box, UL listed as rain-tight. Cast aluminum box and cover with ground flange, neoprene gasket and stainless steel cover screws.
 - M. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, outside flanges, recessed cover box for flush mounting, UL listed as rain-tight. Cast iron box and plain cover with neoprene gasket and stainless steel cover screws.
 - N. Provide plenum rated/listed boxes for all plenum rated areas required by local code.
 - O. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
 - P. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.
 - Q. Provide enclosures for terminal blocks, motor starters, switches, contactors, relays, control stations, controllers, transformers, and panel boards complying NEMA 250 and suitable for surface mounting, as follows:
 1. Exterior Locations: NEMA Type 3R
 2. All Other Locations: NEMA Type 1, unless otherwise indicated.
- 2.7 SLEEVES FOR RACEWAYS
- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
 - B. Coordinate sleeve selection and application with selection and application of firestopping specified.
- 2.8 SLEEVE SEALS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
 - B. 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.
 - C. Refer to Section 26 05 00 "Common Work Results for Electrical" for additional information and requirements.

PART 3 - EXECUTION

- 3.1 GENERAL
- A. Determine exact route and location of all electrical materials prior to installation.

- B. Verify exact locations and elevations of electrical materials with project and field engineer prior to installation, where dimensions are not indicated.
- C. Install electrical materials as indicated with offsets, fittings and changes in elevations as required to make adjustments for obstacles or interferences.
- D. Do not allow electrical materials installation to cause any equipment to be unserviceable or inoperable.

3.2 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: Rigid steel conduit.
 - 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 - 3. Underground Conduit: Rigid steel conduit or Rigid Nonmetallic Conduit as indicated on drawings.
 - 4. In Slab Aboveground: Not allowed.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT or IMC or RGS.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT or IMC or RGS.
 - 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock and warehouse where potential damage exists from fork lifts.
 - 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 or IMC or RGS.
 - 5. Install IMC and fittings except as follows:
 - a. Install EMT conduit and fittings if conduit size is 2 inches or smaller, unless another type of conduit and fittings are indicated.
 - b. Install RGS and fittings where noted or required by NFPA 70 or by federal state, and local governments or agencies having jurisdiction.
 - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 7. Damp or Wet Locations: Rigid steel conduit.
 - 8. Raceways for Optical Fiber or Communications Cable. Plenum-type, optical fiber/communications cable raceway or metallic conduit as indicated.
 - 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R in damp or wet locations. Use NEMA Type 4x in Kitchens and areas subject to corrosion.
 - 10. For coolers and freezers (inside locations), utilize IMC conduit with threaded fittings. Utilize seal-off fittings for all cooler and freezer wall

penetrations to stop condensation in conduits from forming. Install seal-off on warm side. Utilize bell type boxes with threaded hubs and sealed coverplates for all junction boxes and for wiring devices.

- C. Minimum Raceway Size: 3/4-inch trade size for power and 1-inch for data/voice/AV cabling. Size conduit for conductors installed per NEC fill requirements.
- 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.
 - 3. EMT: Use compression fittings. Set screw type not allowed.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz when noted on drawings. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Aluminum conduits not allowed.

3.3 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. Route all exposed conduit parallel or perpendicular to building lines and above accessible ceiling as required. Exposed conduit shall not be installed in finished areas unless permitted by the Owner and architect
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
 - 3. All raceways and conduit shall be run concealed. Fish through existing walls and ceilings as required. In the event concealed conduit is impossible, surface mounted metallic raceways (wire mold) shall be used with the approval of the architect. Surface mounted conduit shall also be used when specifically designated on the drawings in locations where exposed conduit is the predominant wiring method currently in use. Contractor may modify or add to that system with exposed conduit necessary to achieve design results. Exposed conduit in finished areas shall not be installed unless approved by the architect. Conduit installation shall be accomplished in a neat workmanlike manner. Run tight to walls at ceiling edge. Coordinate final routings in the field with the architect prior to installation. All exposed conduits shall be painted to match surrounding area. See **Paragraph 3.6 – SURFACE RACEWAY** for additional information.
- C. Route conduit runs above the bottom chords of steel roof support joists. **Do not install conduits above top chord of bar joists, in web of roof**

decking, or within 6" of deck. This is to prevent roofing nails from puncturing conduits.

- D. Maintain minimum of 6 inches clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances. Install horizontal raceway runs above water and steam piping.
- E. Complete raceway installation before starting conductor installation.
- F. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- G. Ensure conduit is aligned in a neat, uniform manner and arranged to maintain headroom
- H. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
- I. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent addition conduit.
- J. Do not fasten conduit with wire, perforated pipe straps or from ceiling grid support wires. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
- K. Support conduits and trapeze hangers from top cord of bar joists. Do not support from bottom chord of bar joists.
- L. Install conduit free from dents and bruises. Plug ends to prevent entry of dirt, debris, and moisture during installation.
- M. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plan and keep straight legs of offsets parallel, unless otherwise indicated.
- N. Install raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- O. Arrange stub-ups so curved portions of bends are not visible above the finished slab. Protect stub-ups from damage where conduits rise through floor slabs.
- P. 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.
- Q. Conceal conduit within finished walls and ceilings, unless otherwise indicated.
- R. Cut ends of conduit square. Ream ends of field-cut conduit and remove burrs.
- S. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 1. Join conduit butt-tight in couplings.
 - 2. Use insulating bushings to protect conductors.
- T. Tighten nuts of threadless fittings/compression fittings with suitable tools.
- U. Use conduit bodies to make sharp changes in direction, around beams.

- V. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size.
- W. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- X. Raceways Embedded in Slabs: Not allowed.
- Y. 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.
- Z. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - 2. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.
 - 3. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- AA. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- BB. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- CC. Raceways for Communications Cable: Install raceways as follows:
 - 1. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 - 2. 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.
- DD. 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.
 - 3. Where conduit passes through concrete foundations, walls, and floors, to prevent the passage of water by hydrostatic pressure.
 - a. Tighten wall and floor sleeve seal nuts until sealing grommets have expanded to form watertight seal.
- EE. Where conduit penetrates fire-rated walls and floors, provide pipe sleeve two sizes larger than conduit; and fill sleeve with fire-resistive intumescent

compound. Fire-stop installation shall be UL listed equal to or exceeding rating of wall, floor, or ceiling.

- FF. Route conduit through roof opening for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket.
- GG. Use PVC-coated rigid steel factory elbows for bends in plastic conduit runs longer than 100 feet, or in plastic conduit runs which have more than two bends regardless of length.
- HH. Install expansion fittings complete with bonding jumpers where conduits cross building expansion joints.
- II. Install smoke and fire-stop fittings where required by code.
- JJ. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- KK. All conduit stubs installed for communication cabling/technology cabling shall have bushing and end fittings installed so as to protect cables from being damaged when being pulled.
- LL. Install conduit sleeves, J-hooks and other supports for communication/technology cabling contractor.
- MM. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections. Utilize plenum rated raceways when required by local codes.
- NN. For exterior roof applications utilize B-line C-port series supporting devices so as not to damage roof system.
- OO. All cooler and freezer conduits installed within these enclosures shall be held off all walls and ceilings by 1/2 inch unless otherwise dictated by the Health Department.

3.4 BOXES INSTALLATION

- A. Rigidly fasten boxes or solidly embed boxes in concrete or masonry as applicable.
- B. Do not install round boxes where conduit must enter side of box.
- C. Install knockout closure to cap unused knockout holes where blanks have been removed.
- D. Provide electrical boxes as shown on drawings, and as required for splices, taps, wire pulling, equipment connection and code compliance.
- E. Electrical box locations shown on contract drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

- F. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of required access doors with general contractor.
- G. Locate and install to maintain headroom and to present a neat appearance.
- H. **Do not install boxes back-to-back in walls.** Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls. Fill conduit openings with "duct seal" in acoustic-rated walls.
- I. Locate boxes in masonry walls, at center of cell, and install box flush with surface of wall. Coordinate masonry, cutting to achieve neat openings for boxes. Patch all over-cuts.
- J. Support junction boxes and pull boxes independently of conduit. Utilize junction boxes listed for ceiling fans/supporting method where ceiling fans are indicated. Support per manufacturer's direction.
- K. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems and where 277 volt light switches are used. Provide separate conduit feeds for each gang section.
- L. Install boxes in walls without damaging wall insulation.
- M. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- N. Position junction boxes to located luminaires as shown on reflected ceiling plans.
- O. In accessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- P. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- Q. Align wall mounted outlet boxes for switches and similar devices.
- R. Provide cast outlet boxes in exterior locations exposed to the weather and wet locations.
- S. Set floor boxes level and flush with finish flooring material.
- T. Use cast iron floor boxes for installation in slab on grade.
- U. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

3.5 WIREWAY INSTALLATION

- A. Install wireway at lighting transformers and panel boards to allow for the neat and workmanlike arrangement of conduits.
- B. Install wireway system in accordance with manufacturer's installation instructions.
- C. Route wireway parallel or perpendicular to building lines.

- D. Maintain minimum of 12 inches clearance at flues and heat sources.
- E. Install wireway system with allowance for expansion and contraction.
- F. Ensure wireway is aligned in a neat uniform manner.

3.6 SURFACE RACEWAY (ONLY WITH APPROVAL OF ARCHITECT)

- A. Use in finished areas where exposed conduit is not acceptable.
- B. Use flat-head screws to fasten channel to surfaces, mount plumb and level.
- C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- D. Maintain grounding continuity between raceway components to provide a continuous grounding patch.
- E. Fastener Option: Use clips and straps suitable for the purpose.

3.7 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified.
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified.
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
 - 5. 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 of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
 - 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.
 - 7. Install underground tracer lines in trench above raceway.
 - 8. Finish grade area disturbed and return to condition found. Seed/sod areas as required and water as necessary until root growth has occurred.

3.8 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified.
- 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. If above accessible ceiling, sleeves can extend 1 inch out of wall.
- F. Extend sleeves installed in floors to above accessible ceiling.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. 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.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials.
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.
- N. Furnish and install sleeves for all low voltage cabling, including Data, Voice, Video, Intercom/Paging, Clock, Thermostat, Fire Alarm, Security, etc. All sleeves shall be provided with end bushing/fitting to protect cabling. Sleeves shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required. Minimum sleeve size is 3/4 inch conduit. Use minimum of 1-1/4 inch conduits for low voltage data/voice cabling.

3.9 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.

3.10 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 as specified.

3.11 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.

3.12 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- D. Submit a complete nameplate listing for Owner approval.

1.4 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.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and

Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

1.6 WARRANTY

- A. Provide a (1) one year warranty on all parts and labor.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. 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.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- 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.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches 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 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.

2.4 FLOOR MARKING TAPE

- A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
 - 1. Where floors are unfinished, i.e., concrete, utilize paint striping or tape as directed by Owner. For finished floors, i.e., VCT tile, tape shall be used.

2.5 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.
- C. Tag: All locations use Type indicated below:
 - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - 2. Overall Thickness: 5 mils.
 - 3. Foil Core Thickness: 0.35 mil.
 - 4. Weight: 28 lb/1000 sq. ft..
 - 5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi. Utilize 6-inch for duct banks.

2.6 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."
 3. Potential Arc Flash Warning: "DANGER - ARC FLASH PROTECTION REQUIRED WHEN WORKING ON EQUIPMENT." Identify level of PPE protection required per ARC flash and Fault Current Coordination Study.
 4. Final Label type to match Owner's current format.

2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Fasteners for Nameplates and Signs: Self-tapping, rivets, stainless steel screws or No. 10/32, stainless steel machine screws with nuts and flat and lock washers (for NEMA-1 locations only). Utilize appropriate fixtures for wet locations.

2.9 CABLE TIES

- A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- B. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.
 5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior). All paint types to be reviewed/approved by the Architect before use.
1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
 2. Exterior Concrete Unit Masonry:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Exterior semigloss acrylic enamel.
 3. Exterior Ferrous Metal:
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior semigloss alkyd enamel.
 4. Exterior Zinc-Coated Metal (except Raceways):
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior zinc-coated metal primer.
 - 2) Finish Coats: Exterior semigloss alkyd enamel.
 5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):
 - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior concrete and masonry primer.
 - 2) Finish Coats: Interior semigloss alkyd enamel.
 6. Interior Concrete Unit Masonry:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
 7. Interior Gypsum Board:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior gypsum board primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
 8. Interior Ferrous Metal:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior ferrous-metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
 9. Interior Zinc-Coated Metal (except Raceways):
 - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior zinc-coated metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 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 maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- I. Painted Identification: Comply with requirements for surface preparation and paint application.

3.2 SWITCH AND RECEPTACLES COVER PLATES

- A. Install identification label on all switch and receptacle coverplates. Identify power panel and circuit information for each device (i.e. "PP1-#15").
- B. Label shall be clear, 3/8" Kroy or Brothers self-laminating vinyl label with black letters, font size to be determined by Owner and type "Swiss 721 Bold". Embossed Dymo-Tape labels are not acceptable. Permanently affix label to the coverplate, centered above receptacle opening or switch.
- C. Also include identification inside of receptacle or switch box. Utilize permanent marker/Sharpie and neatly print panel and circuit information as noted above.

3.3 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 30-foot maximum intervals.

- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Fire Alarm System: Red.
 2. Normal Power Distribution System: Silver.
 3. Optional Standby Emergency Power Distribution System: Yellow.
 4. Life Safety Emergency Power Distribution System: Orange.
 5. Security System: As requested by the Owner.
 6. Mechanical and Electrical Supervisory System: As requested by the Owner.
 7. Telecommunication System: As requested by the Owner.
 8. Ground: Green.
- C. 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.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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.
- D. Power-Circuit Conductor Identification: 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.
- E. Branch-Circuit Conductor Identification: Label outside of all junction boxes above ceiling with panel and circuit information. Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number.
- F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

- H. 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.
- I. 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.
- J. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts for all power panels and equipment requiring working clearances. 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.
- K. 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.
- L. 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.
- M. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions.
- N. 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 power panels, disconnect switches, transformers 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: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/4-inch-high letters on 1-1/2-inch-high label; where two or more lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, 4 inches high.

- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Pull boxes and junction boxes: 3/8" Kroy tape or Brothers self-laminating vinyl label, color coded same as conduits or permanent magic marker/Sharpie (color coded) and neatly hand labeled/printed with all Capital Letters. In rooms that finished/painted with exposed boxes, install information on inside of coverplate.
- e. 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.
- f. Include the following system information on each laminate tag for control equipment (starters, VFDs, contactors, control switches).
 - 1) Equipment type and tagging from drawings.
 - 2) Location of equipment being served if not located within line of sight.
 - 3) Voltage and phasing of equipment.
 - 4) Panel and circuit numbers serving equipment.
 - 5) Method of control (auto or manual) and controlled from where.
 - 6) Example of mechanical device feed:
 - a) EXHAUST FAN EF-1 (LOCATED ON ROOF OVER TOILET ROOM 222).
 - b) 208V, 3-PHASE.
 - c) FED FROM PPH-1, #1,3,5.
 - d) TIED TO BMS SYSTEM, AUTO CONTROL.
- g. Include the following system information on each laminate tag for power distribution equipment:
 - 1) Equipment type and tagging from drawings.
 - 2) Voltage and phasing of equipment.
 - 3) Name of upstream equipment and location if not within line of sight.
 - 4) Rating and type of OCP device serving the equipment it is not within line of sight.
 - 5) Example of distribution panel device:
 - a) DISTRIBUTION PANEL DP-H1.
 - b) 480Y/277V
 - c) FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELECTRICAL ROOM).
- h. Include the following system information on each laminate tag for transformer equipment:
 - 1) Equipment type and tagging from drawings.
 - 2) Name of the upstream equipment and rating.
 - 3) Voltage and phasing and kva rating of equipment.
 - 4) Location of the upstream equipment and location if not within line of sight.
 - 5) Example of distribution panel device:
 - a) TRANSFORMER TR-07.
 - b) 480V: 208Y/120V, 75KVA.
 - c) FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELECTRICAL ROOM).

2. Color Coding of Systems:
 - a. Black letters on white face for normal power.
 - b. White letters on red face for emergency power.
 - c. White letters on green face for grounding.
 - d. Black letters on yellow face for Caution or UPS.
3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved or engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - f. Emergency generators and transmitter switches.
 - g. Emergency system boxes and enclosures.
 - h. Motor-control devices.
 - i. Enclosed switches.
 - j. Enclosed circuit breakers.
 - k. Enclosed controllers.
 - l. Variable-speed controllers.
 - m. Push-button stations.
 - n. Power transfer equipment.
 - o. Contactors.
 - p. Remote-controlled switches, dimmer modules, and control devices.
 - q. UPS equipment.
 - r. Voice and data cable terminal equipment.
 - s. Security systems.
 - t. Intercom and clock systems.
 - u. Fire-alarm control panel and annunciators.
 - v. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, apply to this Section.
- B. Section 26 27 26 Wiring Devices.
- C. Section 26 51 00 Interior Lighting.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Indoor occupancy/vacancy sensors.
 - 2. Daylight Harvesting Sensors
 - 3. Power Packs.
 - 4. Emergency Power Packs
 - 5. Emergency lighting control relays
 - 6. Low voltage control switches/dimmer switches.

1.3 DEFINITIONS

- A. DT: Dual technology.
- B. LED: Light-emitting diode.
- C. PIR: Passive infrared.

1.4 REFERENCES

- A. FCC Rules and Regulations, Part 15, Subpart J – Radio frequency Interference.
- B. FS W S 896 Switch Toggle
- C. International Energy Conservation Code (IECC).
- D. NEMA WD 1- General Color requirement for wiring devices.
- E. NEMA WD 7- Occupancy Motion Sensors.
- F. NFPA 70- National Electrical Code (NEC).
- G. UL Standard 916- Energy Management Equipment.
- H. UL 924- Emergency Lighting and Power Equipment.
- I. UL 1472- Solid State Dimming Controls.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated and used on the project.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring for all devices.
 - 2. Sensor coverage patterns for all locations. Include additional sensors for areas without overlapping coverage as part of this scope of work.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.6 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. All sensors must be NEMA WD-7 listed; otherwise the manufacturer and contractor will be liable for all expenses associated with the installation of additional sensors, power packs, conduit and wiring to provide adequate coverage of area identified.
- B. All sensor manufacturers need to provide certification that their products (microphonic/ultrasonic sensors) do not interfere with hearing aids and are A.D.A. compliant.
- C. All sensor manufacturers need to provide certification that their products (ultrasonic sensors) do not interfere with Smart Board or other Media type electronic devices. Contractor is responsible for replacing all devices (at their expense) to conform to these requirements. Coordinate devices with Owner's Information Services Department prior to ordering.

1.7 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.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described as follows for each product used:
 - 1. One (1) occupancy/vacancy sensors of each type and size.
 - 2. One (1) daylight harvesting sensor of each type and size.
 - 3. One (1) power packs of each type and size.
 - 4. One (1) emergency lighting control relays of each type and size.
 - 5. One (1) low voltage lighting control switches of each type.
 - 6. One (1) low voltage lighting control dimmer switches of each type.
 - 7. One (1) low voltage replacement buttons of each type.

1.9 WARRANTY

- A. Provide a five (5) year comprehensive warranty. Warranty shall cover all parts and labor.

PART 2 - PRODUCTS

2.1 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.2 SWITCH-BOX OCCUPANCY SENSORS (SEE DRAWINGS FOR ADDITIONAL INFORMATION)

- A. Available Manufacturers:
 - 1. Acuity/Sensor Switch, Inc.
- B. Description: Programmable occupancy/vacancy type sensor, PIR and dual tech type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; and rated for 1200 W at 277-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/3-hp motors, minimum.
 - 1. Include ground wire.
 - 2. Time Delay, Selectable: Automatic adjust and fixed adjustable in steps from 5 to 30 minutes.
 - 3. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keeps lighting off when selected lighting level is present.
 - 4. Color: Utilize White for color of devices unless otherwise directed by the Architect and Owner.

2.3 INDOOR OCCUPANCY/VACANCY SENSORS (SEE DRAWINGS FOR ADDITIONAL INFORMATION)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acuity/Sensor Switch, Inc.
- B. General Description: Wall- or ceiling-mounting, solid-state occupancy/vacancy type units with a separate relay unit.
 - 1. The Acuity nCM xx RJB family of nLight ceiling/surface mount occupancy sensors provide a range of networked sensor solutions for applications with finished ceilings (e.g. ceiling tiles, sheetrock, plaster). nCM xx RJB family sensors utilize 100% digital Passive Infrared (PIR) detection and are available with several lens options, providing flexibility for multiple mounting height and coverage pattern requirements. Dual technology occupancy detection can also be added as an option for applications where occupants are stationary for long periods of time. nCM xx RJB

- family sensors are also available with an optional auxiliary low voltage relay for simple integration with a BMS system or other building system. nCM xx RJB family sensors are powered via the nLight network bus. These configurations work standalone and do not require a connection to a larger nLight network.
2. 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 30 seconds to 20 minutes. Also capable of vacancy type operation requiring manual on and auto off.
 3. Sensor Input: 15-24VDC, 3mA, Class 2 (nLight network power)
 4. Sensor Output: 24 VAC/VDC, 1A - Resistive (AR option).
 5. Connection type: RJ-45 nLight Network Port or Low-Voltage Leads (AR option).
 6. Include option for dimming photocell (ADCX) when required and meets project requirements.
 7. Include optional auxiliary low voltage relay (AR option) when required for dry contact output – relay only tracks occupancy by default, ignoring switch and photocell commands.
 8. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 9. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 10. Adjustable settings (e.g. occupancy time delays, photocell set-points) via push-button or SensorView software application
 11. Bypass Switch: Override the on function in case of sensor failure.
 12. Color: Utilize White for color of devices unless otherwise directed by the Architect and Owner.
 13. Standards/Ratings: ROHS and System Component to aid in compliance with Title 24, ASHRAE 90.1, IECC.
 14. **All sensor manufacturers need to provide certification that their products (microphonic/ultrasonic sensors) do not interfere with hearing aids and are A.D.A. compliant.**
 15. **All sensor manufacturers need to provide certification that their products (ultrasonic sensors) do not interfere with Smart Board or other Media type electronic devices. Contractor is responsible for replacing all devices (at their expense) to conform to these requirements. Coordinate devices with Owner's Information Services Department prior to ordering.**
- 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-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-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 in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.
- 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-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.4 DAYLIGHT HARVESTING SENSORS

- A. Manufacture must match occupancy sensor and power pack manufacture used.
1. Acuity/Lithonia, Inc. (BASIS OF DESIGN)
- B. Overview:
1. The nCM ADCX RJB photocell sensors are ceiling/surface mount devices that provide a range of daylight harvesting features for nLight Control System installations with finished ceilings (e.g. ceiling tiles, sheetrock, plaster). The nCM ADCX RJB provides automatic dimming photocell control by default. Ideal for spaces with windows, such as vestibules, corridors, classrooms, or offices, these sensors work by first monitoring daylight conditions in a room. They then signal networked nLight control devices to adjust their dimming outputs (and/or turn lighting off) to obtain maximum energy savings while ensuring adequate lighting levels are maintained.
 2. The nCM ADCX RJB sensor can also be used together with nLight occupancy sensors. Manual override or adjustment of the dimming level is possible via WallPod dimmers or through the SensorView software.

3. The sensor is powered via the nLight network bus and can control fixtures. These configurations work standalone and do not require a connection to a larger nLight network.
- C. DLH sensor shall provide continuous dimming control for 2-wire 0–10V dimming LED drivers based on natural daylight. The nCM ADCX RJB sensor continuously adjusts a space's lighting to achieve maximum daylight harvesting while maintaining a minimum light level, referred to as the set-point. When no daylight is available, the sensor allows the controlled dimmable lighting to operate at its full bright level. As daylight increases and begins to contribute to the overall light level of the room, the Automatic Dimming Control (ADC) feature starts dimming the room proportionally, eventually reaching the full dim level (or optionally switching off, see paragraph below). As the daylight levels fall, the ADC feature will again take control of the lights; reducing the dim level (increasing the brightness) in order to achieve the necessary total light level. At the point when all daylight contribution is gone, lighting will be back at its full bright level.
- D. Features:
1. Controls connection: RJ-45 nLight Network Ports (2 ports via included RJ-45 splitter) or Low-Voltage Leads (AR option).
 2. Set Point of 0-200fc.
 3. Sensor type- blue enhanced photodiode.
 4. Accuracy, +/-1% @ 70°F.
 5. Operating temperature, -4°F to 185°F pending option selected.
 6. Selectable 3- or 8-second dimming rate.
 7. Multiple calibration options.
 8. Low-profile design.
 9. Color: Utilize White for color of devices unless otherwise directed by the Architect and Owner.
 10. Five-year limited warranty.
 11. Low voltage device: 24 Vdc, 22 gauge wire.
 12. Certification by ETL/UL 916.
 13. Input Ratings 15-24VDC, 3mA, Class 2 (nLight network power).
 14. Output Ratings 24 VAC/VDC, 1A - Resistive (AR option).
 15. Relay Type Latching (AR option).
 16. Standards/ Ratings Energy Management Equipment, UL916 (E167435), and System Component to aid in compliance with Title 24, ASHRAE 90.1, IECC.
- 2.5 OUTDOOR LISTED SENSORS
- A. Where shown. Refer to drawings for additional information.
- 2.6 STANDARD nLIGHT POWER PACK
- A. Manufacture must match occupancy sensor and power pack manufacture used.
1. Acuity/Lithonia, Inc.
- B. The nLight nPP16 EFP family of power packs is the workhorse of an nLight system, delivering robust system performance and design versatility for commercial and industrial lighting control applications. The nPP16 EFP family is

capable of switching loads via an internal latching relay designed with robust protection from the harsh switching requirements of LED loads. These power packs also provide nLight system bus power - up to 40mA from each of its two RJ-45 ports - by transforming Class 1 line voltage (120/277 VAC or 347 VAC) to Class 2 low voltage (15 VDC). This power is typically utilized by other nLight devices within the power pack's local control zone; however, remaining power is also made available over the network for Bridges and devices in other zones to utilize.

- C. Power Packs: Robust and reliable mechanically held latching relay device compatible with multiple sensor types, both occupancy and vacancy type.
1. Complies with current Energy Codes, ASHRAE 90.1, CA Title 20/24.
 2. Work in conjunction with Daylight Harvesting, bi-level switching, plug load control and local on/off manual switching.
 3. Fail safe operation to return to close circuiting for turning fixture on for emergency egress.
 4. Photocell ready.
 5. Plenum rated, Class II wires, Teflon coated per U.L. 2043.
 6. U.L. listed for Energy Management Equipment.
 7. Power supply output short circuit protection.
 8. Tested for over 1,500,000 cycles.
 9. Compatible with all lamp types FL, HID, LED, etc. Has high inrush capability, factory calibrated zero cross over for extended life.
 10. Voltage regulated.
 11. Mounts inside of junction box.
 12. Operating Temperature: Warranted Operating Temperature Standard: 14°F to 122°F. Standard: 14°F to 113°F if enclosed within a junction box. LT option: -4°F to 122°F.
 13. Relative Humidity: 0 to 90 percent non-condensing.
 14. Input: 120/277volt AC.
 15. Output: 120/277volt AC. 16A - Tungsten, Standard Ballast, Electronic Ballast. General Purpose 120VAC, 50/60 Hz, 1/2 HP -Motor. SCCR rating equal to 5KA. Has 100mA, 0-10VDC Dimming Sink Current.
 16. Relay type: Latching.
 17. Low Voltage Output Ratings 15VDC, 40mA per RJ-45 Port (80mA total).
 18. Class Rating: 0-10V Dimming can be wired Class 1 or 2.
 19. EFP: With external fault protection.
 20. Connection Type: RJ-45 nLight Network Ports (2). Non-Dimming Model has Line Voltage Leads. Dimming Model has Line and Low Voltage Leads.

2.7 EMERGENCY nLIGHT POWER PACK

- A. Manufacture must match occupancy sensor and power pack manufacture used.
1. Acuity/Lithonia, Inc.
- B. The nLight nPP16 ER EFP family of power packs is the workhorse of an nLight system, delivering robust system performance and design versatility for commercial and industrial lighting control applications. The nPP16 ER EFP switches loads via an internal latching relay designed with robust protection from the harsh switching requirements of LED loads. Optional 0-10V dimming outputs (D or DS options) are designed with circuit isolation and provide up to 100mA of current sinking capability. The nLight nPP16 ER EFP Series relay pack

is used to switch luminaires powered via an emergency circuit. The nLight nPP16 ER EFP relay pack is ideally suited for use in conjunction with a standard nnPP16 EFP power/relay pack that controls a zone's normal powered lighting.

- C. Emergency Power Packs: Robust and reliable mechanically held latching relay device compatible with multiple sensor types, both occupancy and vacancy type.
1. Automatically Overrides Emergency Lights On To Full Brightness Upon Normal Power Loss.
 2. Complies with current Energy Codes, ASHRAE 90.1, CA Title 20/24.
 3. Complies with Life Safety Emergency Power Equipment UL924 and Energy Management Equipment, UL916 (E167435).
 4. Work in conjunction with Daylight Harvesting, bi-level switching, plug load control and local on/off manual switching.
 5. Photocell ready.
 6. Plenum rated, Class II wires, Teflon coated per U.L. 2043.
 7. U.L. listed for Energy Management Equipment.
 8. Power supply output short circuit protection.
 9. Tested for over 1,500,000 cycles.
 10. Compatible with all lamp types FL, HID, LED, etc. Has high inrush capability, factory calibrated zero cross over for extended life.
 11. Voltage regulated.
 12. Mounts inside of junction box.
 13. Operating Temperature: Warrantied Operating Temperature Standard: 14°F to 122°F. Standard: 14°F to 113°F if enclosed within a junction box. LT option: -4°F to 122°F.
 14. Relative Humidity: 0 to 90 percent non-condensing.
 15. Input: 120/277volt AC.
 16. Output: 120/277volt AC. 16A - Tungsten, Standard Ballast, Electronic Ballast. General Purpose 120VAC, 50/60 Hz, 1/2 HP -Motor. SCCR rating equal to 5KA. Has 100mA, 0-10VDC Dimming Sink Current.
 17. Relay type: Latching.
 18. Low Voltage Output Ratings 15VDC, 40mA per RJ-45 Port (80mA total).
 19. Class Rating: 0-10V Dimming can be wired Class 1 or 2.
 20. Connection Type: RJ-45 nLight Network Ports (2). Non-Dimming Model has Line Voltage Leads. Dimming Model has Line and Low Voltage Leads.

2.8 EMERGENCY LIGHTING CONTROL RELAY (For non-nLIGHT devices)

- A. Unit is based on Leviton, Inc. model #ECS00-110 or IOTA ETS20 equivalent. ECS00-110 to be used for non-dimmer controlled light fixtures. For 0-10VDC dimmer controlled light fixtures, use Leviton model #ECS00-DDW and install device flush mounted in ceiling system.
- B. In the past, emergency lights were kept on 24 hours a day to meet life safety codes. Now, you can use a UL 924 listed Emergency Power Control, Model ECS00-110, to convert regular light fixtures into approved emergency lights. The ECS00-110 saves energy and money while ensuring compliance with both life safety and energy codes.

- C. During normal operation, the same room switch, occupancy sensor, relay panel, or lighting control switches regular and emergency fixtures on and off simultaneously.
 - D. During a utility power interruption, the ECS00-110 automatically bypasses the regular lighting controls, turning the emergency lights ON, regardless of switch position.
 - E. The ECS00-110 is ceiling or wall mounted in a junction box with a single gang plaster ring and is usually located in the area where the emergency fixtures are installed.
 - F. The unique feature of the ECS00-110 is the ability to place the unit above the accessible ceiling tile because the unit does not require an accessible test switch. Instead, when the room switch is turned off, the emergency luminaires stay on for 2.5 seconds and indicate that an emergency power source was available and that the ECS00-110, ballast/LED, and lamp(s) are all functioning correctly. This feature replaces a test switch and is approved for this purpose.
 - G. Unit has power indicator LED for utility power (green).
 - H. Mount in 4-11/16" box with extension/mud ring and install device in ceiling tile or gyp ceiling. Refer to manufacture installation instructions for additional information. Label outside of coverplate with unit information.
 - I. All units shall be tested and certified as operational in writing and results included in close out documents.
 - J. ECS00-DDW or IOTA ETS20 DR provides the same features, but also includes an isolated 0-10V relay contact ensure full brightness during utility power interruption, regardless of dimmer model.
 - K. UL 924 listed.
 - L. 5 year warranty.
- 2.9 LOW VOLTAGE LIGHTING CONTROL SWITCHES/DIMMER SWITCHES
- A. Manufacture must match occupancy sensor and power pack manufacture used.
 - 1. Acuity/Lithonia, Inc.
 - B. Refer to drawing notes and details for additional information.
 - C. Low voltage lighting control dimmer switches shall be based on Acuity/Lithonia nPODMA Family of switches:
 - 1. The nPODMA Series WallPods are single gang nLight-enabled decorator wall switches that enable toggle/ raise/lower/scene control of lighting zones. Equipped with soft-click push-buttons, and a green LED indicator for each button, these devices allow field replaceable and custom engraved button options. nPODMA WallPods communicate with other nLight devices, via CAT-5e cable, through RJ-45 connectors and can be daisy-chained to work with nLight power packs to provide switch control operations. The scene control option presents a convenient method of selecting a custom lighting control scene for spaces in which installed, or requesting a global profile scene be run across several remote zones. By default, scene control wall switches are configured as on/off toggle

- switches and are to be customized programmatically through the SensorView software
2. Communicates with nLight network.
 3. Remotely configurable/upgradeable
 4. Soft-click push-button control
 5. Sets lights to one of two or four preset levels with single button push (nPODMA xL versions only)
 6. Scene controllers run locally stored scenes or global scenes (stored on gateway)
 7. Capable of Programming 4 Different Scene Types.
 - a. Local "Profile" Scene — Modifies the operational configuration of up to 80 devices in the local zone. Stopping scene will revert devices to default settings.
 - b. Local "Preset" Scene — Modifies on/off/dim levels for up to 16 local switch groups. Exit scene through additional "preset" scene or WallPod control.
 - c. Global "Profile" Scene — Modifies the operational configuration of any devices on the system. Stopping scene will revert devices to default settings. Scene is stored on the system Gateway.
 - d. Global "Preset" Scene — Modifies on/off/dim levels for up to 128 global switch groups. Exit scene through additional "preset" scene or WallPod control.
 - e. Easy-to-install screwless wall plate design offers a clean, uninterrupted aesthetic for a more refined look in the space.
 - f. A full range of color options provides a variety of choices for your building designs with the assurance that the housing and the wall plate match.
 - g. 1, 2, or 4 channel on/off.
 - h. 1, 2, or 4 channel raise/lower.
 - i. "Dynamic" options for custom button names when pairing with Acuity Brands nTUNE fixtures.
 8. Include custom engraving to match Owner's requirements.
 9. Input Ratings 15-24VDC, 5mA, Class 2 (nLight network power).
 10. Standards/Ratings Energy Management Equipment, UL916 (E167435).
 11. Mounting, single and multi-gang junction box as required.
 12. Connection Type RJ-45 nLight Network Ports (2).
 13. Warrantied Operating Temperature 32°F to 140°F, LT Option: -4°F to 140°F.
 14. Relative Humidity Up to 90%, Non-Condensing.
 15. Color: Utilize White for color of devices unless otherwise directed by the Architect and Owner.
- D. Low voltage lighting control toggle on/off switches.
1. Switches will be compatible with the above referenced dimmer switches and be able to integrate with system for 3-way and 4-way switching. Refer to Wiring Device specifications for additional information on standard toggle switch devices.
 2. Refer to drawing notes and details for additional information.
 3. The nPODM xS Series WallPods are single gang nLight-enabled devices that provide one, two, and four scene control. These units provide a convenient method of selecting a custom lighting control scene for the

room in which it is installed, or requesting a global profile scene be run across several remote zones. By default, however, the buttons of an nPODM xS are configured as on/off toggle switches. Scenes are programmed to these units utilizing available SensorView software. The nPODM xS has soft-click push-buttons with a green LED indicator for each button. These buttons are field replaceable and can be custom engraved. Two RJ-45 connectors allow the nPODM xS to be daisy-chain wired with CAT-5e cabling to other nLight network devices. The nPODM xSB offers individual on/off buttons for each scene. Pressing the "on" button will reset the expiration time of a scene back to the original programmed time.

4. Input Ratings 15-24VDC, 5mA, Class 2 (nLight network power).
5. Mounting, single and multi-gang junction box as required.
6. Connection Type RJ-45 nLight Network Ports (2).
7. Warrantied Operating Temperature 32°F to 140°F, LT Option: -4°F to 140°F.
8. Relative Humidity Up to 90%, Non-Condensing.
9. Color: Utilize White for color of devices unless otherwise directed by the Architect and Owner.

2.10 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: Plenum rated Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Plenum rated Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Network Control Cable: Plenum rated Cat-5e or greater. T568B wiring convention recommended for nLIGHT systems. Include associated jacks as required for a complete installation.

PART 3 - EXECUTION

3.1 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. Install additional sensors as required to meet coverage requirements at no additional cost to the Owner.

3.2 POWER PACK INSTALLATION

- A. Mount all power packs in junction box for containment of device and associated wiring. Nipple into adjacent power junction box for lighting control switch legs. Refer to drawing details for additional information.

3.3 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. All exposed wiring in finished spaces shall be installed in metallic wiremold raceway.
- 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.
- E. 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.
- F. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- G. All 0-10volt wiring and control wiring shall be separated from line voltage power circuits and shall be plenum rated; otherwise installed in a raceway system with cabling insulation rated for 600volts. Do not install low voltage wiring that is partially not in raceway and also contained in raceway with other line voltage circuits. Once installed with line voltage circuits, it must remain entirely within a raceway system per code.
- H. Install all wiring in conformance with Division 26 and 27 specifications.
- I. Do not install any cable above top chord of bar joists or within 6" of roof deck to prevent damage caused by roofing nails.
- J. Support all cabling independently of other systems.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting system.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
 - 3. Identify all power circuits with panel and circuit information.
- B. Provide custom engraving on all low voltage control switches as selected by the Owner and/or as designated on project drawings.
- C. Label any time switches and contactors with a unique designation.

3.5 COMMISSIONING (COORDINATE ALL WORK WITH THE OWNER)

- A. Provide factory-certified field service engineer to ensure proper system installation and operation under following parameters:
1. Certified by the equipment manufacturer on the system installed.
 2. Site visit activities:
 - a. Verify connection of power feeds and load circuits.
 - b. Verify connection of controls.
 - c. Verify system operation control by control, circuit by circuit.
 - d. Obtain sign-off on system functions.
 - e. Demonstrate system capabilities, operation and maintenance and educate Owner's representative on the foregoing.
 3. At least three site visits to accomplish the following tasks:
 - a. Prior to wiring.
 - 1) Review and provide installer with instructions to correct any errors in the following areas:
 - a) Low voltage wiring requirements.
 - b) Separation of high and low voltage wiring runs.
 - c) Wire labeling.
 - d) Load schedule information.
 - e) Switching cabinet locations and installation.
 - f) Physical locations and network addresses of controls.
 - g) Ethernet connectivity.
 - h) Load circuit wiring.
 - i) Connections to other systems and equipment.
 - j) Placement and adjustment of Occupancy Sensors (when specified).
 - k) Placement and adjustment of Photocells (when specified).
 - b. After system installation:
 - 1) Check and approve or provide correction instructions on the following:
 - a) Connections of power feeds and load circuits.
 - b) Connections and locations of controls.
 - c) Connections of low voltage inputs.
 - d) Connections of the data network.
 - 2) Turn on system control processor and upload any pre-programmed system configuration.
 - 3) Verify device address(es).
 - 4) Upload pre-programmed system configuration and information to switching and/or system devices.
 - 5) Check load currents and remove bypass jumpers.
 - 6) Verify that each system control is operating to specification.
 - 7) Verify that each system circuit is operational according to specification.
 - 8) Verify that manufacturers' interfacing equipment is operating to specification.
 - 9) Verify that software supplied by the manufacturer are performing to specifications.
 - 10) Have an owner's representative sign off on the above-listed system functions.

- c. Before project completion and hand-off:
 - 1) Demonstrate system capabilities and functions to owner's representative.
 - 2) Train owner's representative on the proper operation, adjustment, and maintenance of the system.
- B. Notification: Upon completion of the installation, the contractor shall notify the manufacturer that the system is ready for formal checkout. Notification shall be given in writing a minimum of 21 days prior to the time factory-trained personnel are required on site. Each field installed RJ45 connection must be tested prior to system interconnection. A test report must be furnished to manufacturer prior to scheduling commissioning activity. Manufacturer shall have the option to waive formal turn-on.
- C. Turn-On: Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, Manufacturer's Certified Technician shall completely check the installation prior to energizing the system. Each installed device shall be tested for proper ON/OFF/dimming operations, and proper LED illumination. Each installed device shall be tested verifying that each controlled load adjusts to the selected setting and that all switch LED's illuminate properly.
- D. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

3.6 ADJUSTING

- A. Manufacturer's Representative shall be on site to work with contractor in setting up and adjusting all sensors prior to completion of project. Manufacturer's Representative will certify in writing that work was performed for each device installed.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.
- B. The manufacturer's representative shall provide system training for up to four people as selected by the Owner. Training manuals will be provided for each person. The session will last at least two hours and be video recorded for the Owner's future use. Training video to be saved to USB memory stick, coordinate exact format with Owner. Contact the Owner at least two weeks prior to training for proper scheduling of the event. The contractor will provide to the Owner a typed outline of the events at the training session and the list of who attended."

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, special receptacles and associated device plates.
 - 2. Snap switches.

1.3 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.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 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.

1.6 REFERENCES

- A. NFPA 70 National Electrical Code.
- B. DSCC W-C-896D- General Specification for Electrical Power Connector.
- C. WD 1-1979 general-purpose wiring devices.
- D. WD 5 specific-purpose wiring devices.
- E. W-C-596 electrical power connector, plug, receptacle and cable outlet.
- F. W-S-896 switch, toggle.

1.7 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Switches: Two (2) of each type and size.
 - 2. Receptacles: Two (2) of each type and size.
 - 3. Keys: Minimum of 10 percent, but no fewer than ten (10).

1.9 WARRANTY

- A. Provide minimum (1) one year warranty on all parts and labor unless manufacturer's warranty is greater.

PART 2 - PRODUCTS

2.1 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. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
 - 4. Cooper.

2.2 STRAIGHT BLADE RECEPTACLES (TAMPER RESISTANT)

- A. Tamper Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, DSCC W-C-596G and UL 498, NEMA heavy duty spec grade class (federal specification listed); 2-pole, 3-wire one piece integral grounding strap with green hexagonal equipment ground screw; ground terminal and poles internally connected to mounting yoke; rated at 20 amperes, 125 volts; back and side wiring, metal plaster ears; NEMA configuration 5-20R, unless otherwise indicated. Terminals must accept #10 AWG wire.
1. Hubbell #5352-TR series, Leviton 5362 series, P&S 5362 series and Cooper 5362 series. Color-White.
 2. For emergency power receptacles (fed from generator system) utilize Hubbell #SNAP8300WLTR Snap connector receptacle with Snap connector. Receptacles to be 120volt, 20amp tamper resistant, red in color with illuminated face and include red coverplate engraved with emergency. Utilize GFCI devices of the same type when installed outdoors or near water sources per NEC. Other manufacturers to provide equivalent product.

2.3 STRAIGHT BLADE RECEPTACLE WITH USB CHARGING (TAMPER RESISTANT)

- A. USB Charging Convenience Receptacles, 125V, 20A: heavy-duty Spec grade, NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, tamper resistant. Receptacle shall incorporate USB Type A & C charging ports with a 5.0Amp output at 5VDC, compatible with USB A & C devices, including Apple products.
1. Typical to Hubbell #USB20AC5 series. Color-White. Provide appropriate junction box size to fit receptacles. Other manufacturers to provide equivalent product. **Verify final USB charging port type with Owner prior to ordering.**

2.4 GFCI RECEPTACLES (TAMPER RESISTANT)

- A. Tamper Resistant straight blade, duplex. 125V, 20A, GFCI, heavy duty spec grade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped, and meeting UL GFCI July 28, 2006, lock-out requirements and incorporates automatic self testing. Provide appropriate junction box size to fit receptacles.
1. Typical to Hubbell #GFTRST20 series. Color-White. Other manufacturers to provide equivalent product.
- B. Receptacles used outdoors and/or in damp locations shall also be listed as "WR" (weather resistant). All exterior receptacles shown on drawings as WP-GFI shall utilize weather resistant, tamper resistant, GFCI type receptacles per code. Equivalent to Hubbell #GFTWRST20 series. Color-White. Other manufacturers to provide equivalent product.

2.5 SNAP SWITCHES

- A. Comply with NEMA WD 1, W-C-896F and UL 20.

- B. Wall switches: NEMA heavy-duty spec grade class (federal specification listed); rated at 20 amperes, 120/277 volts; AC quiet quick make, quick break design; toggle handle with totally enclosed case; mounting yoke insulated from mechanism with stainless steel grounding clip; single pole, side wiring, metal plaster ears. Terminals must accept #10 AWG wire. Motor rating – 80%, tungsten rating – 100%.
1. Hubbell #HBL1221, Leviton 1221-2, P&S PS20AC1, Cooper AH1221 Series. Color-White.
 2. For 3-Ways: Hubbell 1223, Leviton 1223-2, P&S PS20AC3, Cooper AH1223. Color-White.
- C. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
1. Switch: 20 A, 120V ac.
 2. Receptacle: NEMA WD 6, Configuration 5-20R.
 3. Color-White.
- D. Pilot light switches: NEMA heavy-duty spec grade class (federal specification listed); rated at 20 amperes, 120/277 volts, AC quiet quick make, quick break design; lighted red polycarbonate toggle handle, when switch in on position; neon lamp; mounting yoke insulated from mechanism with stainless steel group clip; single pole; side wiring. Terminals must accept #10 AWG wire. Motor rating – 80%, tungsten rating – 100%:
1. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
 2. Hubbell HBL1221PL, Leviton 1221-PLR, P&S PS20AC1-RPL, Cooper AH1221PL.
 3. Color-White.
- E. Key-Operated Switches, 120/277 V, 20 A:
1. Description: Single pole, with factory-supplied key in lieu of switch handle.
 2. Hubbell HBL1221L, Leviton 1221-2L, P&S PS20AC1-L, Cooper AH1221L.
 3. Color-White.
- F. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
1. Color-White.
- G. 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. Color-White.
- 2.6 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: UL Listed High impact, self-extinguishing smooth nylon material, Color-White. Coordinate exact finish/type with architect prior to ordering.
 3. Material for Unfinished Spaces: Galvanized steel.

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 lockable cover. Receptacle covers to be of the in-use type.

2.7 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 1. Wiring Devices Connected to Normal Power System: Utilize "White" for color of devices unless otherwise directed by the Architect and Owner or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: Red.
 3. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 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.
 5. Install devices and assemblies level, plumb, and square with building lines.
 6. Install wall dimmers 48 inches to top of cover plate above floor, derate ganged dimmers as instructed by manufacturer; do not use common neutral.
 7. Mount receptacles horizontally with bottom of plate cover 16 inches above floor, unless otherwise indicated.
 8. Mount wall switches vertically with top of plate cover 48 inches above floor, unless otherwise indicated.
- 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. Clean dirt and debris from electrical boxes and remove moisture prior to installing wiring devices.
 2. 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.
 3. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 4. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 5. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 6. 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.
 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, unless device is rated for #10 wire.
 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.
 11. When using stranded wires (when allowed) on receptacles and light switches, avoid fraying of wires around terminals. Wrap sides of devices with electrical tape when complete.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
 2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- F. Device Plates:
1. 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.
 2. Remove wall plates and protect devices and assemblies during painting.

3. Install blank finished coverplates over all abandoned openings in finished areas.
 4. Install blank finished coverplates over all telecommunication (voice data), video and other technology related junction boxes that are not activated with cabling.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 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 printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes. Coordinate with Owner prior to making up labels.**
 2. Identify all circuitry information on all above ceiling junction boxes and within outlet and switch boxes. Black permanent marker labeling is acceptable.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems." Bond all junction box ground wire pigtails to grounding wire and wiring device grounding screw.
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. 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.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
 2. 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.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, and enclosed controllers.

1.3 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. Submit on translucent log-log graph paper.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified, include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
 - 4. Coordination charts and tables and related data.

1.4 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.

1.5 REFERENCES

- A. UL 198C- High Interrupting Capacity Fuses: Current Limiting.
- B. UL198E- Class R Fuses.
- C. DS W-F-870- Fuseholders (For plug and enclosed cartridge fuses).
- D. Comply with NEMA FU 1 for cartridge fuses.
- E. Comply with NFPA 70, National Electrical Code.
- F. All devices shall be U.L. listed.

1.6 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F for more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.7 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.8 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 Ten (10) percent of quantity installed for each size and type, but no fewer than three (3) of each size and type.

1.9 WARRANTY

- A. Minimum of one (1) year warranty on all parts and labor. Include greater warranties if manufacture's base warranty is greater than one year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.

2. Eagle Electric Mfg. Co.; Cooper Industries.
3. Mersen (formerly Ferraz Shawmut, Inc.).
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses; class and current rating, with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 1. Class RK-1, time delay for over 200amp, but equal to or less than 600amp.
 2. Class RK-5, for fuses less than or equal to 200amp.
 3. Control Circuits: Class CC, fast acting or time delay as required to protect circuit servicing.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Provide spare fuse puller.
- C. The over current device coordination was based on a particular size and type. Any substitution of brand, size or type of fuse from that specified, must be preceded by the submittal of a complete coordination study for the substitute over current protection scheme.
- D. Furnish and install Bussmann spare fuse cabinet with spare fuses.

3.4 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.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, apply to this Section.
- B. Fuses Specification Section 26 28 13.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers (MCCBs).
 - 4. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 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 UL 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. Submit on translucent log-log graph paper.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.

- D. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Manufacturer's field service report.
- F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified, include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. 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. Submit on translucent log-log graph paper.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL, such as UL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.
- F. All devices shall be U.L. listed.

1.6 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.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect, Construction Manager and Owner 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, Construction Manager's and Owner's written permission.
4. Comply with NFPA 70E.

1.7 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.
- B. Coordinate sizing of switches, breakers and fuses with mechanical contractor and other tradesman equipment shop drawings prior to ordering equipment.

1.8 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 (3) of each size and type.
 2. Fuse Pullers: Two for each size and type.
 3. All exterior disconnect switches shall be provided with a weatherproof padlock, all with matching tumblers/keys. Provide a minimum of six (6) keys to the Owner.

1.9 WARRANTY

- A. Provide (1) one year warranty on all parts and labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Square D; a brand of Schneider Electric.
 2. All other manufacturers require Owner approval to bid on project.

2.2 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Quick Make-Quick Break, Single Throw, 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, with load interrupter enclosed visible blade knife switch.
- B. 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. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Quick Make-Quick Break, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position, with load interrupter enclosed visible blade knife switch.
- B. 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. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 4. Hookstick Handle: Allows use of a hookstick to operate the handle.
 5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS (ALL BREAKERS SHALL BE COORDINATED WITH FAULT CURRENT COORDINATION STUDY)

- A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- B. 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.
- C. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting. To be used with motor starters and VFC's, which are furnished with overload protection.
- D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings (For breakers 1200 amps or more):
 1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I^2t response.

- E. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip) for Life Safety protection.
- F. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical 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. Type HACR for heating, air conditioning and refrigeration equipment.
PROVIDE THE FOLLOWING WHERE INDICATED ON DRAWINGS:
 - 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. Accessory Control Power Voltage: Integrally mounted, self-powered.

2.5 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. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

2.6 FUSES

- A. Fuses 600 amperes and less: Dual element, current limiting, time delay, UL class RK 1, 600 volt Type LPS-RK or 250 volt type LPN-RK as required, UL listed, 200,000 AIC (RMS), Bussmann low-peak dual element fuses.
- B. Fuses 601 amperes and larger: Current limiting, time delay, UL class L, 600 volt Type KRP-C, UL listed, 200,000 AIC (RMS), Bussmann hi-cap time delay fuses.
- C. All fuses shall be of the same manufacturer. See Division 26 Section 26 28 13 "Fuses" for additional information.
- D. The over current device coordination was based on the fuse sizes and types specified. Any substitution of brand, size or type of fuse from that specified, must be preceded by the submittal of a complete coordination study for the substitute over current protection scheme.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated. Provide concrete bases where required and anchor all equipment.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1, NEMA PB 1.1 and PB 2.1.

3.3 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.
- B. Install arc flash warning labels and identify level of PPE protection required.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. 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.
- D. 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.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 3.5 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- 3.6 CLEANING
- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.
- 3.7 TRAINING
- A. Provide one hour training session for Owner's personnel on electrical breakers when used. Provide Operation and Maintenance Manuals for each person. At completion of training, provide certification letter to Owner stating completion of training and attach copy of sign-in sheet showing all personnel present.

END OF SECTION

SECTION 26 29 13

ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL (U.L.) acceptable to authorities having jurisdiction.
 - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Qualification Data: For qualified testing agency.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified, include the following:
 1. Routine maintenance requirements for enclosed controllers and installed components.
 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 3. Manufacturer's written instructions for setting field-adjustable overload relays.
 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.
- G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
 2. Agency, within 50 miles of project site, capable of providing training, parts and emergency maintenance and repair.
- 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 NFPA 70.
- D. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in 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 Architect, Construction Manager and Owner no fewer than seven days in advance of proposed interruption of electrical systems.
 - 2. Indicate method of providing temporary utilities.
 - 3. Do not proceed with interruption of electrical systems without Architect's, Construction Manager's and Owner's written permission.
 - 4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, 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 as specified.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.
- F. Coordinate unit sizes with mechanical contractor prior to ordering.

1.9 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. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 2. Indicating Lights: Two of each type and color installed.
 - 3. Auxiliary Contacts: Furnish one spare for each size and type of magnetic controller installed.
 - 4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.
 - 5. Coils: Equal to 10 percent, but not less than one of each type and size.

1.10 WARRANTY

- A. Provide (1) one year warranty on all parts and labor unless manufacturer's standard warranty is for greater period of time.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D.
 - 2. All other manufacturers require Owner approval prior to bidding.

2.2 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Fractional Horsepower Rated Manual Controllers: NEMA ICS 2 Heavy Duty, Class A, "Quick-make, quick-break" toggle action; marked to show whether unit is off, on, or tripped.
 - 1. Configuration: Nonreversing.
 - 2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 - 3. Surface mounting.
 - 4. Red pilot light.
 - 5. Nameplates: Identifying unit name and number serving.
- C. Integral Horsepower Manual Controllers: NEMA ICS 2 Heavy Duty, Class A, "Quick-make, quick-break" toggle action; marked to show whether unit is off, on, or tripped.
 - 1. Configuration: Nonreversing.
 - 2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase,

- matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
3. Surface mounting.
 4. Red pilot light.
 5. Additional Nameplates: Identifying unit name and number serving.
 6. N.O./N.C. auxiliary contact convertible.
- D. Magnetic Controllers: Full voltage, across the line, electrically held, NEMA ICS 2, Class A.
1. Configuration: Nonreversing.
 2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 4. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.
 5. **Solid-State Overload Relay:**
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic adjustable and selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - e. Analog communication module.
 6. Two (2) N.C./N.O, NEMA ICS 2, isolated overload alarm convertible contact.
 7. External overload reset push button.
 8. Red pilot run light.
 9. With hand-off-auto selector switch.
 10. Control Relays: Auxiliary and adjustable time-delay relays as required.
- E. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means. (To be used on all multi-pole phase motors requiring automatic starting means unless otherwise indicated.)
1. Includes all components of magnetic controllers plus the following devices listed below.
 2. MCP Disconnecting Means:
 - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.

- d. N.C./N.O. alarm contact convertible that operates only when MCP has tripped.
- e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

2.3 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Other Wet or Damp Indoor Locations: Type 4.

2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard Gray paint with corrosion resistant primer coated applied to factory-assembled and -tested enclosed controllers before shipping.

2.5 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.
 - a. Push Buttons: Shrouded types; momentary as indicated.
 - b. Pilot Lights: LED types; colors as indicated; push to test.
 - c. Selector Switches: Rotary, hand-off, auto type.
 - 2. Elapsed Time Meters: Heavy duty, vibration proof, with digital readout in hours; resettable.
- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

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

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall (especially if walls are damp or susceptible to becoming wet). For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- D. Select heaters based on actual nameplate full-load amperes after motors have been installed. Adjust all electronic thermals to actual nameplate full-load amperes after motors have been installed.
- E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- F. Comply with NECA 1.
- G. Coordinate all equipment with mechanical/equipment contractor prior to ordering equipment to ensure proper sizes/H.P. ratings.
- H. Motor data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor and voltage/phase rating. Provide plastic laminate label on front on motor starter as called for in electrical identification section.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified 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 nameplate.
 - 3. Label each enclosure-mounted control and pilot device.
- B. Install ARC Flash PPE labels on all starters.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system connection point. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables." Coordinate work with control systems contractor control point.

- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors. DO NOT BYPASS SAFETY DEVICES.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect, Construction Manager and Owner before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect, Construction Manager and Owner before increasing settings.
- C. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

3.7 PROTECTION

- A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 CLEANING

- A. Clean enclosed controllers internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.
- B. Schedule training with Owner through Architect with at least seven day advance notice. Provide minimum of one hour of training with approved training manuals and video record session for Owner's future use.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, apply to this Section.
- B. All LED light fixtures must be DLC (DesignLights Consortium) approved.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. LED lighting fixtures
 - 2. Exterior LED wall packs attached to building.
 - 3. Emergency lighting units.
 - 4. Exit signs.
 - 5. Lighting fixture supports.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including occupancy sensors and power packs.
 - 2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
- C. The Electrical/Lighting Contractor must hold an ICC – Energy Efficiency Installer Certification in order to bid on this project and perform lighting work that will allow the Owner to obtain Energy Efficiency incentives. No exceptions.
- D. The Electrical/Lighting Contractor will be required to survey all existing lights after school hours in areas of construction no later than one week after award of contract in order to assist the Owner in developing Energy Incentive Worksheets to obtain funding. Refer to paragraph 1.6 for additional requirements.
- E. Review all lighting incentive requirements with Owner and utility company.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CEE: Consortium for Energy Efficiency.
- C. CRI: Color-rendering index.
- D. CU: Coefficient of utilization.
- E. DCEO: Department of Commerce and Economic Opportunity.
- F. DLC: Design Lights Consortium.

- G. EISA 2007: Energy Independence and Security Act of 2007.
- H. IEMA: Illinois Municipal Electric Agency
- I. IESNA: Illuminating Engineering Society of North America.
- J. LED: Light emitting diode.
- K. LER: Luminaire efficacy rating.
- L. Luminaire: Complete lighting fixture, including ballast housing if provided.
- M. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. LED drivers.
 - 4. Lens types.
 - 5. Energy-efficiency data.
 - 6. Life, output, and energy-efficiency data for lamps.
 - 7. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, drivers, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. For specialized fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
 - 1. Wiring Diagrams: Power and control wiring.
- C. Coordination Drawings: Reflected ceiling plan(s) and other details, 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. Lighting fixtures.
 - 2. Suspended ceiling components.
 - 3. Structural members to which suspension systems for lighting fixtures will be attached.
 - 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.

5. Perimeter moldings.

- D. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- E. Qualification Data: For agencies providing photometric data for lighting fixtures.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. LED fixtures must be certified by DLC (Design Lights Consortium).
- 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. All fixtures shall be U.L. listed.
- D. Comply with NFPA 70 and local code requirements.
- E. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- F. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
- G. Reference ANSI C78.377-2008- Specifications for the Chromaticity of Solid State Lighting Products.
- H. Reference ANSI C82.77-2002- Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B. Complete an inventory of all existing light fixtures (survey to be conducted after school hours) scheduled to be removed with the same information as identified in Paragraph-C below so that Owner can apply for Energy Incentives. Include pictures of all fixture lamp and ballast combination for each type of fixture to be removed.
- C. All new light fixtures shall be audited and a report provided to the Owner so that they may apply for any available energy incentives. Provide spreadsheet showing fixture type, fixture quantity and fixture wattages on a per room basis. Include breakdown on each fixture type for ballast/driver type wattage, lamp type/wattage and overall fixture wattage. Refer to Energy Incentive

Worksheets for all documentation required. Include pictures of all fixture LED lighting engine and driver combination (including fixture energy label) for each type of fixture to be installed.

1.7 WARRANTY

- A. Standard Warranty: (1) one year parts and labor on all fixtures unless manufacturer's standard warranty is greater.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: Five (5) years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining four (4) years.
- C. Special Warranty for LED Fixtures: Manufacturer's standard form, made out to Owner and signed by fixture manufacturer and contractor agreeing to replace lamps/LEDs and drivers that fail in materials or workmanship, within specified warranty period indicated below.
 - 1. Warranty Period: Minimum five (5) years from date of Substantial Completion.

1.8 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. Lamps: (2) of each type and rating installed.
 - 2. Plastic Diffusers and Lenses: (2) of each type and rating installed.
 - 3. Emergency Light Battery: (1) for each emergency lighting unit type installed.
 - 4. Exit Light Battery: (1) for each emergency lighting unit type installed.
 - 5. LED Driver: (2) of each type and size installed.

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 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

1. Where fire rated ceilings or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.
- B. LED Fixtures: Comply with UL 1598 and UL 8750. Test in accordance with IESNA LM-79 and LM-80 standards, and DLC certified.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging. Include integral junction box compartment.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
 4. Laminated Silver Metallized Film: 90 percent.
- G. Plastic Diffusers, Covers, and Globes:
 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.
 2. Glass: Annealed crystal glass, unless otherwise indicated.
- H. All new light fixtures (and associated drivers) must comply with lighting control requirements and any dimming capability.

2.3 LIGHTING FIXTURES

- A. Refer to drawings for lighting schedule.
- B. Acceptable Manufacturers – LED Luminaries.
 1. Acuity/Lithonia (USED AS BASIS OF DESIGN)
 2. Axis Lighting
 3. Other manufacturers as specified on drawings.

2.4 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs: LEDs for AC Operation: LEDs, 70,000 hours minimum rated lamp life, 25 year.

- C. Self-Powered Exit Signs (**Battery When Noted**): Integral automatic charger in a self-contained power pack.
1. Battery: Sealed, maintenance-free, nickel-cadmium type, 15 year prorated warranty; lead calcium type, 5 year prorated warranty. Full 2 year coverage warranty.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.5 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type, 5 year prorated warranty; nickel-cadmium type, 15 year prorated warranty. Full 2 year coverage warranty.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 6. Lamp: LED MR16 LED engine or equivalent.

2.6 LED LAMPS AND DRIVERS

- A. Acceptable Manufacturers:
1. CREE
 2. G.E.
 3. Lighting Science.
 4. Equivalent lighting manufacture "brand name" equivalent. Must be branded with lighting manufacturer's name only.
- B. All lamps shall be from one manufacturer and shall be Energy Star listed.
- C. Low-Temperature Driver Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures minus 20 deg F and higher.
- D. Driver/LED Characteristics:
1. All lighting systems must be listed by DLC and by U.L

2. Power- multitap voltage for LED Class-I drivers with high performance heat sinks.
3. Power Factor: > 0.9 at full load.
4. Operating at universal voltage from 120-277v, auto detecting or independent leads as provided by manufacture.
5. Total Harmonic Distortion: < 20% at full load.
6. Integral weathertight electrical box with terminal strips (12Ga-20Ga) for easy power hookup.
7. Integral 10kV surge suppression protection standard.
8. To address inrush current, slow blow fuse or type C / D breaker should be used.
9. Patented NanoOptic Product Technology
10. **CCT 4000K (+/- 300) as selected by the Owner during shop drawing process.**
11. CRI- Minimum 82.
12. LED rated for minimum of 50,000 hours and minimum of 80%LED lumen maintenance at that point.
13. Minimum of 89% efficiency and low EMI.
14. Efficacy of at least 115 lumens/watt.
15. Capable of dimming from 100% - 0% (or as noted) flicker free and compatible with dimming system specified (line voltage and/or 0-10 volt as specified.)

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- H. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer and provided by manufacturer to support their fixture. Cable support shall be anchored to structural steel and not ceiling system.
- I. Do not support fixtures from conduit or from ceiling grid system. All fixtures to be supported from structure above ceiling. Fixtures can be clipped to grid for preventing lateral movement.

2.8 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

- A. Refer to drawings for light fixture schedule.

2.9 FINISHES

- A. Fixtures: Manufacturers' standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Troffers to be painted after fabrication.

2.10 SOURCE QUALITY CONTROL

- A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.
- B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The contractor will be required to inventory all existing lights in rooms under construction and provide a spreadsheet to the Owner with the following for each room: fixture type, quantity, number of lamps (type) and wattage for each fixture. The contractor will then need to do the same for all new room lighting fixtures including the amount of occupancy/vacancy sensors installed. This is required so the Owner can apply for a lighting energy grant based on overall reduced power consumption.
- B. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- C. Where fire rated ceilings or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.
- D. Where recessed fixtures are installed in gypsum board ceilings, include plaster frames and include support wires to structure above.
- E. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings or gypsum ceilings:
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture, minimum #12 gauge. Locate not more than 6 inches from lighting fixture corners. Rods/wire must be installed from structure and sized in order to support each fixture independently of grid. Wire shall have breaking strength of the weight of the fixture at a safety factor of 3 times units weight. Provide no more than 2" of slack in each fixture support cable after fixtures have been installed within grid.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application, per NEC 410-16-C.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees. Install at least one independent support rod or wire from structure to a tab on each end of lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- F. Suspended Lighting Fixture Support:
 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end. Utilize uni-strut in order to keep individual fixtures in a row uniform in mounting heights. Refer to drawings for additional information. Paint out to match surrounding area.
 4. Continuous Extruded Rows: Suspend from structure with aircraft cable listed by manufacturer for application. Do not fasten to grid ceiling.
 - G. Adjust aimable lighting fixtures to provide required light intensities.
 - H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
 - I. All junction boxes used for supporting light fixtures will be heavy duty UL listed for the application. Do not support from ceiling grid. Support from structure and use grid to stabilize unit.
 - J. All flexible metal conduit connections shall be 6 feet 0 inches or less. Utilize plenum rated raceways when required per local code.
 - K. All conduit shall be supported from structure independently from grid ceiling and/or support wires. Do not anchor to ceiling or light fixture support wires.
 - L. Provide flange kits for all fixtures recessed mounted in gypsum ceilings.
- 3.2 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.
- 3.3 FIELD QUALITY CONTROL
- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
 - B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
 - C. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

- D. Five (5) months and eleven (11) months after fixture installation, contractor shall walk the building and replace all failed devices. DO NOT USE OWNER'S ATTIC STOCK. Provide documentation to Owner showing all fixtures that were worked on for the Owner's records. This procedure does not relieve the contractor from performing warranty work that is brought to their attention by the Owner.

3.4 ENERGY GRANTS

- A. All existing and new light fixtures shall be audited and a report provided to the Owner so that they may apply for any available energy grants. Provide spreadsheet showing fixture type, fixture quantity and fixture wattages on a per room basis.
- B. Assist the Owner with all requested documentation to obtain energy grants.
- C. Provide proof of contractor ICC Certification with bid documents.
- D. Provide company information, lighting drawings and lighting calculation spreadsheet documentation as requested by energy incentive requirements to obtain all lighting incentives available.

END OF SECTION

SECTION 27 05 00

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Grout.
 - 4. Common communications installation requirements.

1.3 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications 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 pathways, 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 communications items that are behind finished surfaces or otherwise concealed.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified.

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.2 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.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS 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 communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for all penetrations. 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. If above accessible ceiling, sleeves can extend 1 inch out of wall.
- F. Extend sleeves installed in floors 2 inches above finished floor level in MDF/IDF closets. All other locations to be stubbed to above accessible ceiling space.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway (and raceways). All other sleeves for cabling shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry on both sides of wall.

1. Promptly pack grout solidly between sleeve and wall (on both sides of 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 pathway or cable, using joint sealant appropriate for size, depth, and location of joint.
 - J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements.
 - K. Roof-Penetration Sleeves: Seal penetration of individual pathways 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. Furnish and install sleeves for all low voltage cabling. All sleeves shall be provided with end bushing/fitting to protect cabling. Sleeves shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required. Minimum sleeve size is 1-1/4 inch conduit. Install removable firestopping material (on both ends of conduit) after installing all cables.
 - N. Where walls do not extend all the way up to the building deck, the contractor will continue to install cabling conduit sleeves as if the walls exist. This will aid in future wall construction without damaging cables.
- 3.3 FIRESTOPPING
- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements as specified. Install removable firestopping material in sleeves after cables have been pulled.

END OF SECTION

SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Telecommunications service entrance pathways.
 - 5. Cable Tray.
 - 6. Grounding.
- B. Related Sections:
 - 1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
 - 2. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- D. LAN: Local area network.
- E. RCDD: Registered Communications Distribution Designer.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications (Minimum of Three Years Experience): Cabling Installer must have personnel certified by BICSI on staff.
1. Contractors Company must be licensed by the State of Illinois.
 2. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
 3. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 4. Field Inspector: Currently registered by BICSI as Commercial Installer, Level 2 to perform the on-site inspection.
- 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. All devices shall be U.L. listed.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-D.
- D. Grounding: Comply with ANSI-J-STD-607-B.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.7 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, telephone switch, LAN equipment and related systems that share space in the equipment room.

- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

1.8 WARRANTY

- A. Provide a one year warranty on all parts and labor unless manufacturer standard warranty is for greater period of time.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-D.
- B. Manufacturers shall be ISO-9001 compliant.
- C. Cable Support: U.L. labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
 - 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 - 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 3. Lacing bars, spools, J-hooks, and D-rings.
 - 4. Straps and other devices.
 - 5. Cable tray.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high and 3 inches deep. Verify wall thickness and notify architect if problems encountered with installation of this box size prior to rough-in. Boxes must match coverplates used/specified. Include appropriate mud rings as required. See drawings for details.
 - 2. All new wall construction to have recessed boxes and raceway system. No exposed raceway will be allowed on new wall construction unless otherwise permitted by the Architect under special conditions.
 - 3. Comply with TIA/EIA-569-D for maximum length of conduit and bends between pull points, and for pull-box sizing.
 - 4. Use manufactured conduit sweeps and long-radius ells whenever possible.
 - 5. In telecommunications rooms, position conduit ends adjacent to a corner on backboard (in case of a single piece of plywood) or in the corner of room (where multiple sheets of plywood are installed around perimeter walls of room). Use cable trays to route cables if conduits cannot be located in these positions. Secure conduits to backboard when entering room from overhead.
 - 6. Install minimum 1-1/4-inch conduit stubs for all workstation devices. Stub out to above accessible corridor ceiling/to cable tray or J-hooks; otherwise, provide J-hooks and sleeves. Install end bushings and fittings

for each stub. Install minimum of 3-1/2" sleeves for all penetrations into MDF/IDF closets.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 inches, sized as needed. Comply with requirements for plywood backing panels specified. Paint out white, but DO NOT COVER FIRE LABEL.

2.3 EQUIPMENT FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products equivalent to the following, as approved by Owner.
 - 1. Commscope/Systimax
 - 2. Owner preapproved equivalent.
- B. General Frame Requirements:
 - 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.
 - 3. Finish: Manufacturer's standard, black baked-polyester powder coat.
 - 4. With ground bar.
- C. Floor-Mounted Racks: Modular-type, steel construction.
 - 1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
 - 2. Black, baked-polyester powder coat finish.
 - 3. With ground bar.
- D. Cable Management for Equipment Frames:
 - 1. Metal, with integral wire retaining fingers.
 - 2. Baked-polyester powder coat finish.
 - 3. Vertical cable management panels shall have front and rear channels, with covers.
 - 4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.
- E. Wall Cabinets:
 - 1. Metal, black in color with hinged back and hinged front locking door with clear plexiglass window.
 - 2. 19" mounting rails front and back for supporting equipment.
 - 3. With ceiling fan, low speed, high volume, low noise fan with thermostat switch.
 - 4. With ground bar.
 - 5. With power outlet/surge strip.
 - 6. Mount to fire rated backboard.
 - 7. With multiple raceways to above accessible ceiling for cabling access.

2.4 CABLE TRAY

- A. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by hot-dip galvanizing, color-black, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch thick. Include waterfalls, jointers, wall mounts, pendent mounting kit and ground lug for a complete installation.
 - 1. Basket Cable Trays: Size as noted on drawings. Wire mesh spacing shall not exceed 2 by 4 inches.
 - 2. Ladder Cable Trays: Size as noted on drawings, and a rung spacing of 12 inches.
 - 3. Refer to drawings for other types of cable trays.
 - 4. Manufacturers:
 - a. Commscope/Systemax
 - b. Panduit
 - c. Cablofil.
 - d. Cooper B-Line, Inc.
 - e. GS Metals Corp.
 - f. Mono-Systems, Inc.
- B. Install cable tray in all new IDF closets to support IDF rack cabling pathway requirements.
- C. Bond cable tray to TMGB in IDF closet.

2.5 POWER STRIPS (For each type of rack/cabinet)

- A. Power Strips: Comply with UL 1363.
 - 1. Rack mounting.
 - 2. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 - 3. LED indicator lights for power and protection status.
 - 4. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
 - 5. Cord connected with 15-foot line cord.
 - 6. Rocker-type on-off switch, illuminated when in on position.
 - 7. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
 - 8. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

2.6 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-B.
- C. Grounding Points:
 - 1. **Locate grounding bus bar in each data rack as shown.**
- D. Bonding Conductors:
 - 1. Where a panelboard for telecommunications is located in same room or space as a grounding busbar, bond to equipment ground bus of electrical panelboard.

2. Extend from grounding busbars to ground terminals in equipment racks and cabinets.
- E. Special Requirements:
1. Bonding conductors shall be insulated copper, No. 6 AWG minimum.
 2. Install metallic conduit and conductors shall be bonded at each end of conduit.
 3. Bonding conductors shall be installed without splices unless approved by Engineer because of special circumstances. Where splices are necessary, they shall be accessible and shall be located in telecommunications spaces. Splices shall be by irreversible compression connectors or by exothermic welding.

2.7 LABELING

- A. Comply with TIA/EIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 FIRESTOPPING

- A. Comply with requirements. Comply with TIA/EIA-569-D, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.3 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-B. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-B for Class 2 level of administration including optional identification requirements of this standard.
- C. Labels shall be preprinted or computer-printed type.

END OF SECTION

SECTION 27 13 00

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pathways.
 - 2. 50/125-micrometer, optical fiber cabling.
 - 3. Cable connecting hardware and patch panels.
 - 4. Cabling identification products.
- B. Related Sections:
 - 1. Division 27 Section "Communications Horizontal Cabling."
- C. System shall be a complete operational 1 GIG, Category-6 local area network data cabling system, with a 10 GIG fiber optic backbone, excluding active devices. System shall be certified to this degree. See drawings for part/model numbers.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms and main terminal space in the telecommunications cabling system structure. Cabling system consists of backbone cables, mechanical terminations, and patch cords used for backbone-to-backbone and network switch cross-connection.

- B. Backbone cabling cross-connects will be located in communications equipment rooms. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568.3-D, when tested according to test procedures of this standard.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For all cable, include the following installation data for each type used:
 - a. Cable cut sheet with electrical characteristics.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Cabling administration drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics including the following:
 - a. Patch panels.
 - b. Patch cords (Provided by the Owner).
 - c. Fiber optic boxes.
 - 4. Patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 5. **The data cabling contractor shall provide shop drawings showing the desired cabling routes (through the building) to each area's respective MDF/IDF rack. Routings shall follow primary pathways (i.e. corridors), shortest distance possible and be concealed above lay-in ceilings. Alternate pathways (special conditions) shall be coordinated in the shop drawing stage with the Engineer. Please note that zoning of building is shown on the drawings identifying MDF/IDF rack location serving area**
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector. Provide certification for each.
 - 1. Installer shall be a certified competent installer with a minimum of three years experience installing Category-6/6A 1/10 GIG UTP and 10 GIG fiber optic cabling for data system. Installer shall be certified by Systimax/Commscope manufacturer of communication devices being installed.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Maintenance Data: For splices and connectors to include in maintenance manuals.

- G. Operation and Maintenance Data: All cabling to include operation and maintenance manuals.
- H. Systimax/Commscope 20 Year Extended Product Warranty certificate.
- I. Drawing Data: Include layout drawing of all devices and their labeling scheme.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications (Minimum 3 Years Experience Required installing 10 GIG UTP Cabling and 10 GIG Fiber Optic Cabling): Cabling Installer must have RCDD personnel certified by BICSI on staff.
 - 1. Contractors Company must be licensed by the State of Illinois.
 - 2. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 - 3. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 4. Testing Supervisor: Currently certified by BICSI Level 2 Installer to supervise on-site testing.
 - 5. Installing contractor must have prior experience with at least two projects utilizing Category-6/6A (1/10 GIG), UTP cabling and 10 GIG fiber optic cabling systems.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- C. 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. All devices shall be U.L. listed.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-D.
- E. Grounding: Comply with ANSI-J-STD-607-A.
- F. Source Limitations: Obtain all products through one source from single manufacturer (Systimax/Commscope or equivalent, as approved by Owner).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Do not allow cables to be painted.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute to other participants.
 - 3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

1.11 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. Patch Cords: NA, (Provided by the Owner).

1.12 WARRANTY

- A. Provide a comprehensive cable/premise wiring device warranty from manufacturer of communication device system for no less than 20 years. This shall include a warranty on all parts and labor:
 - 1. The cabling/premise wiring device warranty and system performance guarantee program shall warrant the structured cabling system is free from defects in material and workmanship and will support any current or future Category-6 system applications ratified by IEEE, ANSI or ISO that is developed for an ANSI/TIA/EIA-568.3-D compliant structured cabling system for a 20-year period from date of registered installation. This warranty shall also include a warranty covering all components (work area outlets, horizontal cable, connecting hardware in the horizontal cross-connect, the equipment cord at the work area, and the patch cord in the horizontal cross-connect). All devices must be manufactured by warranty provider.
 - 2. Contractor must be a Certified Installer and accredited Certified Installer for the manufacturer of product being installed, as approved by Owner.

- B. Provide a one-year warranty on all other associated equipment not covered under warranty indicated above.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-D.
- B. Manufacturers shall be ISO-9001 compliant.
- C. Cable Support: U.L. labeled for support of Category-6/6A (1/10 GIG) UTP cabling and 10 GIG fiber optic cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high and 3 inches deep. Verify wall thickness and notify engineer if problems encountered with installation of this box size prior to rough-in. Boxes shall match faceplates used/specified.
 - 2. Comply with TIA/EIA-569-D for maximum length of conduit and bends between pull points, and for pull-box sizing.
 - 3. Use manufactured conduit sweeps and long-radius ells whenever possible.
 - 4. In telecommunications rooms, position conduit ends adjacent to a corner on backboard (in case of a single piece of fire-rated plywood) or in the corner of room (where multiple sheets of plywood are installed around perimeter walls of room). Use cable trays to route cables if conduits cannot be located in these positions. Secure conduits to backboard when entering room from overhead.
 - 5. Install minimum 1-1/4-inch conduit stubs for all workstation devices. Stub out to above accessible corridor ceiling/to cable tray or J-hooks; otherwise, provide J-hooks and sleeves. Install end bushings and fittings for each stub. Where multiple cables are installed, follow NEC 40% fill requirements with additional 50% spare capacity.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 inch, sized as needed. Comply with requirements for plywood backing panels. Paint out white, but DO NOT COVER FIRE LABEL.

2.3 OPTICAL FIBER CABLE (REFER TO DRAWINGS FOR CABLE SCHEDULE)

- A. Manufacturers: Subject to compliance with requirements, provide product equivalent to the following, as approved by Owner:

1. Commscope/Systimax
 2. Owner preapproved equivalent.
- B. Description: OM3/OM4 Multimode, 50/125-micrometer, (X-strands as noted on drawings) strand-fiber armored cable, tight buffer, plenum rated, optical fiber cable capable of supporting 10 GIG systems.
1. Comply with ICEA S-83-596 for mechanical properties.
 2. Comply with TIA/EIA-568-D for performance specifications.
 3. Comply with TIA/EIA-492AAAA-A for detailed specifications.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - b. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262, when armored cable is specified.
 5. Maximum Attenuation: 3.00 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
 6. Minimum Modal Bandwidth: 200 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
 7. Operating Temperature Range: Minus 20 deg C to plus 70 deg C.
- C. Jacket:
1. Jacket Color: Aqua for 50/125-micrometer cable.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-D.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
- D. Install non-armored plenum rated fiber cable in plenum rated innerduct, minimum size of 1-1/4" when armored cable type is not specified. Install and maintain pull strings. Refer to drawings for fiber model type to be used.
- E. Refer to Section 27 15 00 "Communications Horizontal Cabling" for additional cabling requirements and performance requirements.

2.4 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products equivalent to the following, as approved by Owner:
1. Commscope/Systimax
 2. Owner preapproved equivalent.
- B. Patch Panels: Modular panels housing multiple-numbered, "LC" style duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
 2. Panel shall have protective hinge front cover and slide out tray with fiber spools for organization and protection.
- C. Patch Cords:(Provided by the Owner) Factory-made, dual-fiber cables in lengths and color selected by Owner, minimum of 36 inches, refer to drawings for quantity, length and color.

- D. Cable Connecting Hardware:
 - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568.3-D.
 - 2. Quick-connect, duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
 - 3. Armored grounding kit to be installed on all armored cables at rack locations.

2.5 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.
- C. All telecommunication grounding conductors to be installed in raceways. Conduits shall be GREEN in color. Bond both ends of conduit with appropriate bushing. Conduits do not have to be GREEN when installed in a finished space where visible. Install GREEN conduits above accessible ceilings.
- D. All armored fiber optic cabling shall be grounded and bonded to TMGB/TGB telecommunication ground bars in MDF/IDF closets, otherwise to ground bars in data racks if TMGB/TGB is not present per NEC 770.100.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-C and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568.3-D.
- C. Factory test multimode optical fiber cables according to TIA/EIA-526-14-B and TIA/EIA-568.3-D.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, and except in accessible ceiling spaces where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces, unless subject to damage; i.e., Gymnasiums, Locker Rooms, Mechanical Rooms, areas subject to damage, etc.

1. Install plenum cable in environmental air spaces, including plenum ceilings. Utilize plenum rated innerduct for installing fiber optic cables; otherwise, use plenum rated armored fiber optic cabling. Include pull string in each innerduct when used.
 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

- A. Examine pathway elements intended for cables.
1. Verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements. Proceed with installation only after unsatisfactory conditions have been corrected.
 2. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.
 3. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
 4. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Verify that surfaces are ready and clean to receive work.
- C. Verify that quantity and sizes of boxes/conduit are acceptable for installation of jacks and cabling.
- D. Make general contractor and architect aware of any condition on-site that may interfere or cause damage to installation of system.
- E. Beginning installation means installer accepts existing conditions.
- F. Installer shall coordinate work with all tradesmen.
- G. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- H. Comply with TIA/EIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- I. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- J. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- K. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard when entering room from overhead.
 4. Extend conduits above finished floor to devices indicated.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- L. Backboards: Install backboards at locations indicated on drawings.

3.3 APPLICATION OF MEDIA

- A. Backbone Cable for Data Service: Use fiber-optic cable for runs between equipment rooms and wiring closets and for runs between wiring closets. Use plenum rated armored fiber optic cable.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. Furnish and install sleeves for all low voltage cabling. All sleeves shall be provided with end bushing/fitting to protect cabling. Sleeves shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required. Minimum sleeve size is 1-1/4 inch conduit. Utilize multiple 3-1/2 inch sleeves for penetrations into MDF/IDF closets. Install removable fireproofing (on both ends of conduit) after installing cables.
- C. General Requirements for Cabling:
1. Comply with TIA/EIA-568.3-D.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Comply with NECA 1.
 4. Wiring Method: Install cables in raceway except within consoles, cabinets, and accessible ceiling spaces where unenclosed wiring method may be used. Support cabling with J-hooks or cable tray above accessible ceilings. **DO NOT SUPPORT FROM CEILING SUPPORT WIRES.** Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables in all new construction. Install cabling in raceway where subject to damage: locker rooms, gyms, boiler rooms, mechanical rooms, loading docks, etc. and paint out to match area. In finished areas that have no ceilings and are occupied by staff and students, all cabling shall be installed in raceway and painted out to match area. Raceways and boxes are specified in Division 26 Section "Raceways and Boxes for Electrical Systems."
 5. Install 110-style IDC termination hardware unless otherwise indicated.
 6. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 7. Install cables using techniques, practices, and methods that are consistent with Category-6/6A/fiber rating of components that ensure

- Category-6/6A/fiber performance of completed and linked signal paths, end to end.
8. Install cables without damaging conductors, shield, or jacket.
 9. **Do not paint cables as this will void the warranty.**
 10. All horizontal cabling shall terminate back at each area's respective rack. Terminate on patch panel.
 11. All cabling shall be routed through cable tray or J-hook assembly (as noted on drawings) above accessible corridor ceilings. **DO NOT SUPPORT FROM CEILING SUPPORT WIRES.**
 12. All Category rated cables must be within the distance of 295 feet, not required for analog voice. The contractor shall notify the Owner of any locations that exceed this distance limitations prior to installation.
 13. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 14. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 15. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
 16. Contractor shall core floors as required for installation of data cabling. Radar scan floors prior to coring to determine any contents that would be damaged by making these penetrations. Call out any issues encountered to the Architect and Engineer. Verify all locations of cores with architect/engineer in field as possible abatement may be required. All cores shall be sleeved and fire proofed, as required. Field verify all equipment and piping locations before making cores. Under no circumstances will any structural member be cut in this process.
 17. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
 18. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels. Do not install consolidation points. Do not splice cables.
 19. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 20. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 21. Secure and support cables at intervals not exceeding 48 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals. Utilize J-hooks or cable tray. **DO NOT SUPPORT FROM CEILING SUPPORT CABLES.**
 22. Maintain a maximum UTP cable bend radius of four times the cable diameter, six times if in conduit.
 23. Apply plenum rated cable ties loosely and at random intervals.
 24. Minimize the amount of jacket twisting and avoid stretching the cable.

25. Use an appropriate method for dressing and securing cables (i.e., cable ties – wide type, wire management panels, cable support bards and velcro straps).
 26. Do not exceed a 90 degree bend.
 27. Do not over tighten cable ties.
 28. Do not over twist cables.
 29. Do not exceed 25 lbs. of pulling tension. Pull cables simultaneously if more than one is being installed in same raceway. Use manufacturer listed/approved (Category-rated) pulling compound or lubricant if necessary. Use compounds that will not damage conductor insulation. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.
 30. Do not use staple guns to position or fasten cables.
 31. When installing fiber optic cables, maintain minimum bend radius of 20 times cable diameter when pulling and 10 times when installed. Do not kink cable. Install dust cover/caps at both ends of cable when not being terminated.
- D. UTP Cable Installation:
1. Comply with TIA/EIA-568-C.2-1.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry. Strip back only as much cable jacket as required for termination.
- E. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568.3-D.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
 3. Install in plenum rated innerduct.
- F. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. **Do not install cabling above top chord of bar joists or within 6 inches of roof deck so as to avoid damage caused by roofing nails.**
- G. Wiring within Wiring Closets and Enclosures:
1. Install fire-rated plywood backboards on walls of equipment rooms and wiring closets.
 2. Mount patch panels, terminal strips, and other connecting hardware on wall-mounted racks, floor-mounted racks or cabinets as shown on drawings.
 3. Group connecting hardware for cables into separate logical fields.
 4. Train conductors to terminal points with no excess.
 5. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and TIA/EIA-569-D recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 - 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 - 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 FIRESTOPPING

- A. Comply with requirements. Comply with TIA/EIA-569-D, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.
- C. Install sleeves as required for cabling access install end bushing and fitting to protect cabling. Fireproof (both sides of sleeve) after cabling is installed.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.

- C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
- D. Grounding Points:
 - 1. Locate grounding terminals in each equipment rack and cabinet.
- E. Bonding Conductors:
 - 1. Where a panelboard for telecommunications is located in same room or space as a grounding busbar, bond to equipment ground bus of electrical panelboard.
 - 2. Extend from grounding busbars to ground terminals in equipment racks and cabinets.
- F. Special Requirements:
 - 1. Bonding conductors shall be insulated copper, No. 6 AWG minimum.
 - 2. Install in conduit. Metallic conduit that exceeds 36 inches in length, conductors shall be bonded at each end of conduit.
 - 3. Bonding conductors shall be installed without splices unless approved by Engineer because of special circumstances. Where splices are necessary, they shall be accessible and shall be located in telecommunications spaces. Splices shall be by irreversible compression connectors or by exothermic welding.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-C. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: 2.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion about TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-C for Class 2 level of administration including optional identification requirements of this standard.
- D. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.
- E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and

equipment grounding conductors. Provide electronic copy on memory stick to Owner in electronic format compatible with Owner's equipment.

- G. Cable and Wire Identification (**For Oakton Community College**) (Refer to Drawings for Additional Information):
1. Tag all Cat 6 cables at both Communications Equipment Room and the information outlets using the following alphanumeric labeling system:
 - a. Each cable run should have 4 labels. Two wrap around labels on the cable itself, a label on the patch panel and a label on the wall plate.
 - b. The cable labels should be printed on a flexible wrap around white label with black text, using the format (single line, spaces around the slash): IDF-Rack#-Patch Panel#-Patch Panel Port# / Room-port.
 - 1) Example:
0509-1-1-23 / 1530-01
 - c. The wall port labels should be printed on a white label with black text, using the format (Two lines, no slash):
IDF-Rack#-Patch Panel#-Port#
Room-port
 - 1) Example:
0509-1-1-23
1530-01
 - d. The Patch panel labels should be printed on a white label with black text and should include just the Room-port (i.e. 1530-01).
 - e. For all the label types, The IDF is the Communications Equipment Room, the Rack# and Patch Panel# are sequential numbers beginning with the next sequential number based on the marked existing patch panels and racks. The patch panel port # is the position within the patch panel (1-48). For the Room-Port, the Room is the room number. For hallways, it is the room number of the closest adjacent room followed by an H (i.e. 1542H). The port number starts at one with each additional outlet in each room numbered sequentially. If a port is located in the ceiling. (Security camera's, Wireless AP's, projector, etc,) the port should be preceded by a C (for example 1530-C13). All ports, both wall, ceiling and floor should be in the same sequence, i.e. 1530-01, 1530-C02, 1530-03, ...).
 - f. For wall ports, the label should be placed directly on the faceplate and not on the removable paper card under the window.
 - g. All proposed labels must be reviewed by the owner prior to installation.

2. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-C, for the following:
1. Cables use flexible vinyl or polyester that flexes as cables are bent.
- I. Contractor shall bear all costs associated with walking each room/area for verification of actual room numbers prior to labeling, no exceptions. Please note that room numbers could change under this construction project.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Fiber-Optic Cable Tests:
 1. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568.3-D. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Link End-to-End Attenuation Tests:
 - a. Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-B, Method B, One Reference Jumper.
 - b. Attenuation test results for horizontal links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568.3-D.
 - 1) < 2.0 dB for links < 90m.
 - 2) < 2.6dB @ 850nm for links > 90m.
 - 3) < 2.0dB @ 1300nm for links > 90m.
 - 4) All splices shall be no more than 0.3dB.
 - c. Required test data for backbone fiber optic cabling shall include optical attenuation at both 850nm and 1300nm wavelengths. Measurements must be done at both ends of the cable run. Use two-jumper method. Attenuation will vary depending on cable

lengths. Maximum link attenuation shall equal connector attenuation plus cable attenuation plus splice attenuation. Maximum connector attenuation shall be 0.75 dB. Maximum splice attenuation shall be 0.3 dB per splice. Maximum cable attenuation coefficient shall be as follows:

- 1) 3.5 dB / km @ 850nm for 507 / 125um
 - 2) 1.25 dB / km @ 1300nm for 50 / 125um
- d. All power meters shall have an accuracy of + / - 0.5 dB or better. Light source shall be capable of generating light at all appropriate wavelengths.
 - e. All testing shall prove operation of 10 GIG copper system capability on a 10 GIG fiber optic plant.
- D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
 - E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
 - F. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

3.9 MANUFACTURER'S FIELD SERVICE

- A. Upon acceptance of installation registration form, manufacturer will provide at a minimum 20 year Systimax/Commscope Extended Product Warranty on all parts/cabling and labor to repair and/or replace any non-performing device.
- B. Manufacturer's representative shall visit the site to determine if the system complies with all requirements.

3.10 CLEANING

- A. Clean all devices of dust and debris.

3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and extending wiring to establish new workstation outlets.
- B. Provide system demonstration. Show Owner as-builts and how all cabling was routed. Demonstrate method of tagging. Identify what rooms are fed from each rack. Identify spare capacity.
- C. Describe wiring of system and functionality of all jacks and related devices.

END OF SECTION

SECTION 27 15 00

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 01, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pathways.
 - 2. UTP Cat-6 cabling.
 - 3. Cable connecting hardware, patch panels, and cross-connects.
 - 4. Telecommunications outlet/connectors.
 - 5. Cabling system identification products.
 - 6. Cable management system.
- B. Related Sections:
 - 1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
- C. System shall be a complete operational 1 GIG, Category-6 local area network data cabling system, with a 10 GIG fiber optic backbone, excluding active devices. System shall be certified to this degree. See drawings for part/model numbers.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- G. LAN: Local area network.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 - 1. TIA/EIA-568-C.2-1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 - 2. Bridged taps and splices shall not be installed in the horizontal cabling.
 - 3. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable link length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C.2-1, when tested according to test procedures of this standard.
- B. Manufacturer products must be ISO-9001 compliant.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For all cables, include the following installation data for each type used:
 - a. Cut sheet specifications.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Cabling administration drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords (Provided by the Owner).
 - d. Distribution racks/cabinets.
 - e. Terminal racks/cabinets.
 - f. Workstation outlets.
 - 4. Patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 5. Cable tray layout when specified, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.

- c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 - 6. **The data cabling contractor shall provide shop drawings showing the desired cabling routes (through the building) to each area's respective MDF/IDF rack to meet distance limitation of 90 meters. Routings shall follow primary pathways (i.e. corridors), shortest distance possible and be concealed above lay-in ceilings. Alternate pathways (special conditions) shall be coordinated in the shop drawing stage with the Engineer. Please note that zoning of building is shown on the drawings identifying MDF/IDF rack location serving area.**
 - 7. **Please note that the quantity of new patch panels shown are for the contractor's convenience and that final quantity will need to be determined by the contractor prior to bidding. Quantities shall be based on the zoning shown. Should the contractor wish to revise the zoning, quantity of patch panels will need to be revised accordingly.**
 - C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector. Provide Certification for each.
 - 1. Installer shall be a certified competent installer with a minimum of three years experience installing Category-6 1 GIG UTP and 10 GIG fiber optic cabling for data system. Installer shall be certified by Systimax/Commscope manufacturer of communication devices being installed.
 - D. Source quality-control reports.
 - E. Field quality-control reports.
 - F. Maintenance Data: For splices and connectors to include in maintenance manuals.
 - G. Drawing Data: Include layout drawing of all devices and their labeling scheme.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications (Minimum 3 Years Experience Required): Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Contractors Company must be Licensed by the State of Illinois.
 - 2. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 - 3. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 4. Testing Supervisor: Currently certified by BICSI Level 2 Installer to supervise on-site testing.
 - 5. Installing contractor must have prior experience with at least two projects utilizing Category-6 (1 GIG) UTP cabling systems and 10 GIG fiber optic cabling systems.

- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
 - C. 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. All devices shall be U.L. listed.
 - D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-D.
 - E. Grounding: Comply with ANSI-J-STD-607-A.
 - F. Source Limitations: Obtain all products through one source from single manufacturer.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Test cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.
- 1.9 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - B. DO NOT ALLOW CABLES TO BE PAINTED.
- 1.10 COORDINATION
- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
 - B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.
 - C. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute to other participants.
 - 3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
- 1.11 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. Device Plates: One (1) of each type and size.

2. Connectors: Five (5) of each type and color.
3. Patch Cords: NA, (Provided by the Owner).

1.12 WARRANTY

- A. Provide a comprehensive warranty (cabling/premise wiring device of product manufacturer as approved by Owner) approved for no less than 20 years. This shall include a warranty on all parts and labor:
 1. The cabling/premise wiring device warranty and system performance guarantee program shall warrant the structured cabling system is free from defects in material and workmanship and will support any current or future Category-6 1-Gig cabling system and 10-GIG fiber optic cabling system applications ratified by IEEE, ANSI or ISO that is developed for an ANSI/TIA/EIA-568-C.2-1 compliant structured cabling system for a 20-year period from date of registered installation. This warranty shall include a warranty covering all components (work area outlets, horizontal cable, connecting hardware in the horizontal cross-connect, the equipment cord at the work area, and the patch cord in the horizontal cross-connect). All devices must be manufactured by warranty provider.
 2. Contractor must be a Certified Installer and Accredited Installer for the manufacturer of product being installed, as approved by Owner
- B. Provide a one-year warranty on all other associated equipment not covered under warranty indicated above.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-D.
- B. Cable Support: U.L. labeled for support of Category-6/6A (1/10 GIG) cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 2. Lacing bars, spools, J-hooks, and D-rings.
 3. Straps and other devices.
- C. Cable Trays (When Noted):
 1. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch thick.
 - a. Basket Cable Trays: Size as noted on drawings. Wire mesh spacing shall not exceed 2 by 4 inches.
 - b. Ladder Cable Trays: Size and type as noted on drawings, and a rung spacing of 12 inches.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high and 3 inches deep. Verify wall thickness and notify engineer if problems encountered with installation of this box size prior to rough-in. Boxes

must match faceplates used/specified. Install mud rings to match drywall thickness and match coverplate size/type used.

2. Comply with TIA/EIA-569-D for maximum length of conduit and bends between pull points, and for pull-box sizing.
3. Use manufactured conduit sweeps and long-radius ells whenever possible.
4. In telecommunications rooms, position conduit ends adjacent to a corner on backboard (in case of a single piece of plywood) or in the corner of room (where multiple sheets of plywood are installed around perimeter walls of room). Use cable trays to route cables if conduits cannot be located in these positions. Secure conduits to backboard when entering room from overhead.
5. Install minimum 1-inch conduit stubs for all workstation devices. Stub out to above accessible corridor ceiling/to cable tray or J-hooks; otherwise, provide J-hooks and sleeves. Install end bushings and fittings for each stub. Where multiple cables are installed, follow NEC 40% fill requirements.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 inch by size needed. Comply with requirements for plywood backing panels. Paint out white; DO NOT COVER FIRE LABEL.

2.3 UTP CABLE (REFER TO DRAWINGS FOR ADDITIONAL INFORMATION)

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Systimax/Commscope.
 2. Owner preapproved equivalent.
- B. Description: 100-ohm, 4-pair UTP, covered with a low smoke plenum rated thermoplastic jacket.
 1. Comply with ICEA S-102-700 for mechanical properties.
 2. Comply with TIA/EIA-568-C.2-1 for 1 GIG performance specifications.
 3. Listed and labeled by UL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 4. Operating Temperature Range: -20 deg C to 60 deg C.
- C. Horizontal Cabling: Data, Category-6: (**Based on Systimax #2071E Series**)
 1. All cables shall be Category-6, four pair, unshielded twisted pair (UTP) 23 AWG, rated for 250 MHz sweep tested up to 300 MHz. Provide plenum type cables in all plenum environments.
 2. Cables shall be approved manufacturer (listed by the communication device manufacturer) to maintain the extended product warranty requirement.
 3. Cable shall be 23 AWG solid bare copper, FEP insulated and isolated pairs (flex web), twisted pairs, unshielded, ripcord, (**Color-White**) plenum rated jacket and third party verified to EIA/TIA 568.C-2 Category-6 standards.
 4. Cable shall meet or exceed the following standards:

- a. ANSI/TIA-568-C.2 and ISO/IEC 11801 Class-E component compliance.
 - b. IEEE 802.3af (PoE), IEEE 802.3at (PoE+), IEEE 802.3bt (4PPoE Type 3 and 4).
 - c. 10BASE-T through 1GBASE-T Ethernet at 100 meters.
 - d. NEC Article 800 compliant.
 - e. Third party verified.
 - f. UL/c (UL) Listed, LP Listed for product safety in high heat/high power PoE applications.
 - g. HDASE-T Certified.
 - h. RoHS/RoHS 2 Compliant.
 - i. REACH Compliant.
 - j. IEEE 802.11ac high bandwidth/high power wireless access point applications.
 - k. Tested to 80 watts.
5. The cable shall meet the following electrical transmission characteristics:
- a. Mutual Capacitance (CM) – 5.6 nF/100m @1Khz.
 - b. DC resistance unbalance, maximum: 5%
 - c. DC resistance, maximum: 7.71 ohms/100m.
 - d. Nominal velocity of propagation: 71%.
 - e. Cable manufacturer must be certified under ISO-9001.
- D. UTP Plenum Cable: Listed for use in air-handling spaces. Features are as specified for cables, conductors, and UTP cable except materials are modified as required for listing.
- 2.4 UTP CABLE HARDWARE (REFER TO DRAWINGS FOR ADDITIONAL INFORMATION)
- A. Manufacturers: Subject to compliance with requirements, provide products equivalent to the following, as approved by Owner:
1. Systimax/Commscope.
 2. Owner preapproved equivalent.
- NOTE: Manufacturer must be recognized member of cabling device manufacturer's cabling/premise wiring device warranty program.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2-1, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher and of type consistent throughout project.
- C. Patch Panel: Cat-6 UTP 48port patch panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. (**Based on Systimax #360-IPR-1100-E-GS-2U-48**):
1. Number of Jacks per Field: Install one for each four-pair UTP cable indicated, plus spares and blank positions adequate to suit specified expansion criteria.
 2. Mounting: Rack as noted on drawings.
 3. Include rear wire management rail system.
- D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals. (Category-6) (**Based on Systimax #MGS400 Series Jacks**)

1. All jacks shall be eight position, balanced high density Category-6, RJ-45 modular jacks with 110 terminations with T568B (AT&T) wiring configuration; coordinate with Owner.
 2. Jack shall have the ability to accept color coded icons and include color coded wiring instructions on label.
 3. Jacks shall be UL 1863 listed and CSA certified. File numbers shall be made available.
 4. Jack contacts shall be beryllium copper with a precious metal plating with nickel under plating. Jacks must be capable for operating under 802.11ac, PoE+ requirements.
 5. 110 contacts shall be phosphor bronze with 100 micro inch tin plating over nickel.
 6. Jacks shall meet FCC part 68.5
 7. Jacks shall meet TIA/EIA-568-C.2-1 and TSB40 standards.
 8. Jack housing shall be high impact 94 V-0 rated thermoplastic.
 9. Jack shall be suitable for wire sizes ranging from 22 – 24 AWG.
 10. Insulation on conductors shall be no larger than 0.050 inches O.D.
 11. Provide dust covers on all jacks.
 12. Jacks shall be stamped Category-6 on face and be visible once installed in coverplate.
 13. **Color of jacks-White.**
- E. Patch Cords: (Provided by the Owner).
- F. Wire Management: High-capacity horizontal wire cable managers shall be capable of managing high performance cable on the front and rear of any 19" EIA rack (**Based on Panduit #NMF Series**):
1. Include molded unit with bend radius fingers that protect the cables.
 2. Include standard pass through holes that incorporate bend radius control.
 3. Include dual hinged covers.
 4. Size of unit to be coordinated with Owner prior to ordering.
- 2.5 CONSOLIDATION POINTS
- A. NOT ALLOWED.
- 2.6 TELECOMMUNICATIONS OUTLET (REFER TO DRAWINGS FOR ADDITIONAL INFORMATION)
- A. Workstation Outlets: Quantity as noted on drawings, -port-connector assemblies mounted in single or multigang faceplate as required to match conditions.
1. Faceplate: Nylon, complying with requirements in Division 26 Section "Wiring Devices." Refer to drawings for additional information.
 - a. Utilize **white coverplates** unless otherwise directed by the Architect and Owner.
 2. For use with snap-in jacks accommodating any combination of UTP and other audio/video system components. Refer to drawings.
 - a. Flush mounting jacks as noted on drawings.
 3. Legend Field: Snap-in, clear-label covers and machine-printed paper inserts.
 4. When installing above accessible ceilings, label ceiling grid with jack information.

2.7 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-C and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.9 DRAWING DOCUMENTATION

- A. Description: Computer-based cable management system, with integrated database and graphic capabilities, that is compatible with AutoCAD.
- B. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
- C. Information shall be presented in database view, schematic plans, or technical drawings.
 - 1. AutoCAD drawing software shall be used as drawing and schematic plans software.
- D. System shall interface with the following testing and recording devices:
 - 1. Direct upload tests from circuit testing instrument into the personal computer.
 - 2. Direct download circuit labeling into labeling printer.
- E. Incorporate testing results for permanent documentation.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-C.2-1 and TIA/EIA-568.3-D.
- C. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568.3-D.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, and except in accessible ceiling spaces, where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces, unless subject to damage: Gymnasiums, Locker Rooms, Mechanical Rooms, etc.
 - 1. Install plenum cable in environmental air spaces and plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- C. No exposed raceway will be allowed in new wall construction. All new walls will be required to have recessed boxes and raceway. Surface mounted raceway will only be allowed if permitted by the Architect under special conditions.

3.3 INSTALLATION OF PATHWAYS

- A. Examine pathway elements intended for cables.
 - 1. Verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 2. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.
 - 3. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Verify that surfaces are ready and clean to receive work.
- C. Verify that quantity and sizes of boxes/conduit are acceptable for installation of jacks and cabling.
- D. Make general contractor and architect aware of any condition on-site that may interfere or cause damage to installation of system.
- E. Beginning installation means installer accepts existing conditions.
- F. Installer shall coordinate work with all tradesmen.
- G. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-D.
- H. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- I. Comply with TIA/EIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- J. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

- K. Install manufactured conduit sweeps and long-radius elbows whenever possible.
 - L. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits above finished floor to devices indicated.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
 - M. Backboards: Install backboards at locations indicated on drawings.
- 3.4 APPLICATION OF MEDIA
- A. Horizontal Cable for Data Service: Use UTP Category-6 cable for runs between wiring closets and workstation outlets.
 - B. Horizontal Cable for WAP Service: Use UTP Category-6 cable for runs between wiring closets and WAP outlets.
 - C. Horizontal Cable for voice VoIP Service: Use UTP Category-6 cable for runs between wiring closets and workstation outlets.
- 3.5 INSTALLATION OF CABLES
- A. Comply with NECA 1.
 - B. Furnish and install sleeves for all low voltage cabling. All sleeves shall be provided with end bushing/fitting to protect cabling. Sleeves shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required. Minimum sleeve size is 1-1/4 inch conduit. Utilize multiple 3-1/2 inch sleeves for penetrations into MDF/IDF closets. Install removable fireproofing (on both ends of conduit) after installing cables.
 - C. Where walls do not extend all the way up to the building deck, the contractor will continue to install cabling conduit sleeves as if the walls exist. This will aid in future wall construction without damaging cables.
 - D. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-C.2-1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Comply with NECA 1.
 - 4. Wiring Method: Install cables in raceway except within consoles, cabinets, and accessible ceiling spaces where unenclosed wiring method may be used. Support cabling with J-hooks or cable tray above accessible ceilings. **DO NOT SUPPORT FROM CEILING SUPPORT WIRES.** Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables in all new construction. Install cabling in raceway where subject to damage: locker rooms, gyms, boiler rooms, mechanical rooms, loading docks, etc. and paint out to match area. In finished areas that have no ceilings and are occupied by staff and students, all cabling shall be installed in raceway

- and painted out to match area. Raceways and boxes are specified in Division 26 Section "Raceways and Boxes for Electrical Systems."
5. Install 110-style IDC termination hardware unless otherwise indicated.
 6. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and patch panels.
 7. Install cables using techniques, practices, and methods that are consistent with Category-6/6A rating of components and that ensure Category-6/6A performance of completed and linked signal paths, end to end.
 8. Install cables without damaging conductors, shield, or jacket.
 9. **Do not paint cables as this will void the warranty.**
 10. All horizontal cabling shall terminate back at each area's respective rack. Terminate on patch panel. **DO NOT SUPPORT FROM CEILING SUPPORT WIRES.**
 11. All cabling shall be routed through cable tray or J-hook assembly (as noted on drawings) above accessible corridor ceilings.
 12. All Category-6 UTP cables must be within the Category-6 distance of 295 feet. The contractor shall notify the Owner of any locations that exceed this distance limitations prior to installation.
 13. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 14. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 15. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
 16. At workstation location include 15 feet service loop above ceiling for possible future relocation. Support from structure as required, do not lay on ceiling system. Utilize plenum rated Velcro fasteners as required.
 17. Contractor shall core floors as required for installation of data cabling. Radar scan floors prior to coring to determine any contents that would be damaged by making these penetrations. Call out any issues encountered to the Architect and Engineer. Verify all locations of cores with architect/engineer in field as possible abatement may be required. All cores shall be sleeved and fire proofed, as required. Field verify all equipment and piping locations before making cores. Under no circumstances will any structural member be cut in this process.
 18. Install exposed cables above accessible ceilings parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
 19. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels. Do not install consolidation points. Do not splice cables.
 20. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 21. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

22. Secure and support cables at intervals not exceeding 48 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals. Utilize J-hooks or cable tray. **DO NOT SUPPORT FROM CEILING SUPPORT WIRES.**
 23. Maintain a maximum UTP cable bend radius of four times the cable diameter, six times if in conduit.
 24. Apply cable ties loosely and at random intervals.
 25. Minimize the amount of jacket twisting and avoid stretching the cable.
 26. Use an appropriate method for dressing and securing cables, every 12 inches (i.e., cable ties – wide type, wire management panels, cable support bards and velcro straps), per cable manufacturer's recommendation. **DO NOT OVER-TIGHTEN CABLE SUPPORTS.**
 27. Do not exceed a 90 degree bend.
 28. Do not over tighten cable ties.
 29. Do not over twist cables.
 30. Do not exceed 25 lbs. of pulling tension. Pull cables simultaneously if more than one is being installed in same raceway. Use manufacturer listed/approved (Category-6/6A) pulling compound or lubricant if necessary. Use compounds that will not damage conductor insulation. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.
 31. Do not use staple guns to position or fasten cables.
 32. When installing fiber optic cables, maintain minimum bend radius of 20 times cable diameter when pulling and 10 times when installed. Do not kink cable. Install dust cover/caps at both ends of cable when not being terminated.
- E. UTP Cable Installation:
1. Comply with TIA/EIA-568-C.2-1.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry. Strip back only as much cable jacket as required for termination.
 3. Install in raceway where shown.
- F. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart.
 3. **Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Do not route above top chord of bar joists or within 6 inches of deck due to damage caused by roofing nails.**
- G. Wiring within Wiring Closets and Enclosures:
1. Install fire-rated plywood backboards on walls of equipment rooms and wiring closets.
 2. Mount patch panels, terminal strips, and other connecting hardware on wall-mounted racks, floor-mounted racks and cabinets.
 3. Group connecting hardware for cables into separate logical fields.
 4. Train conductors to terminal points with no excess.

5. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - H. Group connecting hardware for cables into separate logical fields.
 - I. Separation from EMI Sources:
 1. Comply with BICSI TDMM and TIA/EIA-569-D recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.
- 3.6 FIRESTOPPING
- A. Comply with requirements.
 - B. Comply with TIA/EIA-569-D, Annex A, "Firestopping."
 - C. Comply with BICSI TDMM, "Firestopping Systems" Article.
 - D. Install sleeves as required for cabling access; install end bushing/fitting to protect cabling. Fireproof (on both sides of sleeves) after cabling is installed.
- 3.7 GROUNDING
- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

- B. Comply with ANSI-J-STD-607-A.
- C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
- D. Grounding Points:
 - 1. Locate grounding terminals in each rack and cabinet.
- E. Bonding Conductors:
 - 1. Where a panelboard for telecommunications is located in same room or space as a grounding busbar, bond to equipment ground bus of electrical panelboard.
 - 2. Extend from grounding busbars to ground terminals in equipment racks and cabinets.
- F. Special Requirements:
 - 1. Bonding conductors shall be insulated copper, No. 6 AWG minimum.
 - 2. Install in conduit. Metallic conduit that exceeds 36 inches in length, conductors shall be bonded at each end of conduit.
 - 3. Bonding conductors shall be installed without splices unless approved by Engineer because of special circumstances. Where splices are necessary, they shall be accessible and shall be located in telecommunications spaces. Splices shall be by irreversible compression connectors or by exothermic welding.
 - 4. All grounding/bonding conduits to be GREEN in color; when exposed in finished spaces, paint out to match existing area.

3.8 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-C. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: 2.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. See Division 27 Section "Communications Backbone Cabling" for additional identification requirements. See Evaluations for discussion about TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-C for Class 2 level of administration including optional identification requirements of this standard.
- D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Provide electronic copy on memory stick to Owner in electronic format compatible with Owner's equipment.

- F. Cable and Wire Identification (**For Oakton Community College**) (Refer to drawings details for additional information):
1. Tag all Cat 6 cables at both Communications Equipment Room and the information outlets using the following alphanumeric labeling system:
 - a. Each cable run should have 4 labels. Two wrap around labels on the cable itself, a label on the patch panel and a label on the wall plate.
 - b. The cable labels should be printed on a flexible wrap around white label with black text, using the format (single line, spaces around the slash): IDF-Rack#-Patch Panel#-Patch Panel Port# / Room-port.
 - 1) Example:
0509-1-1-23 / 1530-01
 - c. The wall port labels should be printed on a white label with black text, using the format (Two lines, no slash):
IDF-Rack#-Patch Panel#-Port#
Room-port
 - 1) Example:
0509-1-1-23
1530-01
 - d. The Patch panel labels should be printed on a white label with black text and should include just the Room-port (i.e. 1530-01).
 - e. For all the label types, The IDF is the Communications Equipment Room, the Rack# and Patch Panel# are sequential numbers beginning with the next sequential number based on the marked existing patch panels and racks. The patch panel port # is the position within the patch panel (1-48). For the Room-Port, the Room is the room number. For hallways, it is the room number of the closest adjacent room followed by an H (i.e. 1542H). The port number starts at one with each additional outlet in each room numbered sequentially. If a port is located in the ceiling. (Security camera's, Wireless AP's, projector, etc.,) the port should be preceded by a C (for example 1530-C13). All ports, both wall, ceiling and floor should be in the same sequence, i.e. 1530-01, 1530-C02, 1530-03, ...).
 - f. For wall ports, the label should be placed directly on the faceplate and not on the removable paper card under the window.
 - g. All proposed labels must be reviewed by the owner prior to installation.
 2. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.

5. Label all Wireless Access Point jacks above ceiling and on ceiling grid below with same information.
 - a. Ceiling Grid Label font type/size shall be **Calibri 16 pt bold**.
 - b. Provide sample to Owner before formal labeling begins.
6. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-C, for the following:
 1. Cables use flexible vinyl or polyester that flexes as cables are bent.
- H. Contractor shall bear all costs associated with walking each room/area for verification of actual room numbers prior to labeling, no exceptions. Please note that room numbers could change under this construction project.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Category-6 UTP Cabling Tests (up to 500 MHz):
 1. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2-1. Perform tests with a tester that complies with performance requirements in Annex I, complying with measurement accuracy specified in Annex H. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - a. Conduct tests and inspections after installation has been completed to assure the Owner's requirements for installation have been met. Upon request, prior to Owner's acceptance, allow access by Owner to test the equipment and wiring system. The contractor shall be responsible for testing each run "end-to-end" (both ways) and certifying, in writing, that the cabling meets Category/Level-6 UTP specifications and is in proper working condition. Each UTP cable shall be fully tested with a level IV tester (i.e., Lantek II-500 and Fluke DTX-1800 series or equal). The output from each UTP cable test/certification shall be printed out and provided to Owner in as-built/close-out documentation.
 - b. Required test data for UTP horizontal cables shall include: wire map, length attenuation, link test, plug de-embedding, ANEXT, AFEXT, PSA NEXT, PSAFNEXT, ACR, ACRF, PSACR, and PSACRF.
 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
 4. Permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal-level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with minimum criteria

in TIA/EIA-568-C.2-1 for Category-6 cable and as required by Systemax/Commscope 20 year Extended Product Warranty.

- D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- F. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

3.10 MANUFACTURER'S FIELD SERVICE

- A. Upon acceptance of installation registration form, manufacturer will provide at a minimum 20 year warranty on all parts/cabling and labor to repair and/or replace any non-performing device.
- B. Manufacturer's representative shall visit the site to determine if the system complies with all requirements.

3.11 CLEANING

- A. Clean all devices of dust and debris.

3.12 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and extending wiring to establish new workstation outlets.
- B. Provide system demonstration. Show Owner as-builts and how all cabling was routed. Demonstrate method of tagging. Identify what rooms are fed from each rack. Identify spare capacity.
- C. Describe wiring of system and functionality of all jacks and related devices.

END OF SECTION

SECTION 27 51 16

PUBLIC ADDRESS SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes extension of existing system:
 - 1. Power amplifiers.
 - 2. Volume limiter/compressors.
 - 3. Loudspeakers.
 - 4. Conductors and cables.
 - 5. Raceways.

1.3 DEFINITIONS

- A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.
- B. VU: Volume unit.
- C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For supports and for control consoles, equipment cabinets and racks, and components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Console layouts.
 - 3. Control panels.
 - 4. Rack arrangements.
 - 5. Calculations: For sizing backup battery.
 - 6. Calculations: For voltage drop based on wire size used.
 - 7. Wiring Diagrams: For power, signal, and control wiring and associated electrical connection of devices.
 - a. Identify terminals to facilitate installation, operation, and maintenance.

- b. Single-line diagram showing interconnection of components.
- c. Cabling diagram showing cable routing.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.
- D. Qualification Data: For qualified Installer and testing agency.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For public address and mass notification systems to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. The manufacturer shall have minimum (10) ten years of documented experience in the design and manufacture of paging system devices and equipment.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project and have minimum of (3) three years documented experience.
 - 1. Personnel certified by NICET as Audio Systems Level II Technician.
 - 2. The contractor shall have InfoComm International (ICIA) Certified Technology Specialist (CTS) on staff and supervising the project. This service shall not be subcontracted.
- C. The CTS shall review all submittals and oversee the project installation including documenting all on site observations, confirm installation meets document requirements, review all testing requirements and approve final testing and calibration of all equipment. All information to be included with close-out documentation.
- D. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.
 - 1. Testing Agency's Field Supervisor: Currently certified by NICET at Level III to supervise on-site testing.
- E. Source Limitations: Obtain public address system from single source from single manufacturer.
- F. Service representative must be located within 60 miles of the project site and be able to provide service within 4 hours of notification.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Comply with NFPA 70.
- I. Comply with U.L. 50.

1.6 REFERENCES

- 1. ADA- Americans with Disability Act.

2. ADAAG- Americans with Disabilities Accessibility Guidelines.
3. NFPA 70 (NEC) National Electrical Code
4. UL 813 Standards for Commercial Audio Systems
5. UL 1480 Speakers for fire Alarm, Emergency and Commercial and Professional Use.
6. 2010 FGI Guidelines Part 2.1-8.3.1.3 Acoustics Considerations
7. Illinois Administrative Code Title 77 Chapter I Subchapter b part 250 Section 25 0. 2500 Electrical Requirements.
8. ISO R 266- 1997
9. ANSI S1.6- 1984

1.7 COORDINATION

- A. Coordinate layout and installation of system components 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.

1.8 EXTRA MATERIALS (REFER TO DRAWINGS FOR ADDITIONAL INFORMATION)

- 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: One (1) of each type and size.

1.9 WARRANTY

- A. Provide one year warranty on all parts and labor.
- B. Standard service must be within 24 hours of notification and Emergency Service must be provided within four hours of notification unless otherwise accepted by the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Speakers:
 1. Atlas Sound LP.
 2. Bogen
- C. Cables:
 1. Belden.
 2. West Penn.
 3. Carol Cable.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. System Functions:

1. Selectively connect any zone to any available signal channel.
2. Selectively control sound from microphone outlets and other inputs.
3. "All-call" feature shall connect the all-call sound signal simultaneously to all zones regardless of zone or channel switch settings.
4. Include live and pre-recorded emergency voice messages. This shall have a priority over all other types of messages or program material.
5. Telephone paging adapter shall allow paging by dialing an extension from any local telephone instrument and speaking into the telephone.
6. Produce a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.
7. Reproduce high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of non-uniform coverage of amplified sound.

2.3 GENERAL EQUIPMENT AND MATERIAL REQUIREMENTS (REFER TO DRAWINGS FOR ADDITIONAL INFORMATION)

- A. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz. Utilize 120volt emergency power sources for connecting all new amplifiers.
- C. Equipment Mounting: Where rack, cabinet, or console mounting is indicated, equipment shall be designed to mount in a 19-inch housing complying with TIA/EIA-310-D.
- D. Weather-Resistant Equipment: Listed and labeled by a qualified testing agency for duty outdoors or in damp locations.

2.4 POWER AMPLIFIERS

- A. Mounting: Rack.
- B. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected wattage for each station and speaker connected in all-call mode of operation, plus an allowance of 25% for future stations. **Please note 70V systems will need to be installed in metallic raceway.**
- C. Total Harmonic Distortion: Less than 3 percent at rated power output from 50 to 12,000 Hz.
- D. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.
- E. Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.
- F. Output Regulation: Less than 2 dB from full to no load.

- G. Controls: On-off, input levels, and low-cut filter.
- H. Input Sensitivity: Matched to preamplifier and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphone or handset transmitter.

2.5 TRANSFER TO STANDBY AMPLIFIER

- A. Monitoring Circuit and Sensing Relay: Detect reduction in output of power amplifier of 40 percent or more and, in such event, transfer load and signal automatically to standby amplifier.

2.6 VOLUME LIMITER/COMPRESSOR

- A. Minimum Performance Requirements:
 1. Frequency Response: 45 to 15,000 Hz, plus or minus 1 dB minimum.
 2. Signal Reduction Ratio: At least a 10:1 and 5:1 selectable capability.
 3. Distortion: 1 percent, maximum.
 4. Rated Output: Minimum of plus 14 dB.
 5. Inputs: Minimum of two inputs with variable front-panel gain controls and VU or decibel meter for input adjustment.
 6. Rack mounting.

2.7 LOUDSPEAKERS

- A. Cone-Type Loudspeakers:
 1. Comply with TIA/EIA SE-103.
 2. Minimum Axial Sensitivity: 95 dB at one meter, with 1-W input.
 3. Frequency Response: Within plus or minus 3 dB from 50 to 15,000 Hz.
 4. Size: 8 inches with 1-inch voice coil and minimum 10-oz. ceramic magnet.
 5. Minimum Dispersion Angle: 100 degrees.
 6. Rated Output Level: 10 W.
 7. Matching Transformer: 70volt input, full-power rated with four taps. Maximum insertion loss of 0.5 dB.
 8. Recessed integral volume control.
 9. Surface-Mounting Units: Ceiling, wall, or pendant mounting, as indicated, in steel back boxes, acoustically dampened. Front face of at least 0.0478-inch steel and whole assembly rust proofed and shop primed for field painting.
 10. Flush-Ceiling-Mounting Units: In steel back boxes, acoustically dampened. Metal ceiling grille with white baked enamel. Include T-Bar grid/tile bridge support system. **Speaker shall be Atlas-SD72W series or approved equal.**

2.8 CONDUCTORS AND CABLES

- A. Jacketed, twisted pair and twisted multipair, untinned solid copper.
 1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch thick rated at 300volts minimum.

2. Microphone Cables: Neoprene jacketed, not less than 2/64 inch thick, over shield with filled interstices. Shield No. 34 AWG, tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent.
3. Plenum Cable: Listed and labeled for plenum installation.
4. Backbone cable:
 - a. Minimum 14/2 shielded with drain wire, plenum rated.
 - b. Basis of Design Belden 6100FE (CMP)
5. Speaker Cable:
 - a. Minimum of 18/2 shielded with drain wire, plenum rated.
 - b. Basis of Design Belden 6300FE (CMP)

2.9 RACEWAYS

- A. Conduit and Boxes: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems."
 1. Outlet boxes shall be not less than 2 inches wide, 3 inches high and 2-1/2 inches deep.
 2. Include raceways for all locations required including for areas with non-accessible ceilings. Minimum size, 3/4" trade size.
 3. Flexible metal raceway can be used between junction box and speaker assembly with length not to exceed 48 inches.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways except within consoles and cabinets.
- B. All cables are to be installed in raceway.
 1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
 2. All exposed raceways installed in finished areas shall be of the metallic wiremold type.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF RACEWAYS

- A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- B. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- C. Install conduit stubs in new construction out to above accessible ceiling.
- D. Please note all 70V systems will need wiring installed in a metallic raceway system.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Cable Installation Requirements:
 - 1. Please note all 70V systems will need wiring installed in a metallic raceway system.
 - 2. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
 - 3. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
 - 4. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
 - 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 7. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used.
 - 8. Install all cables from device to device. Do not splice in between devices.
 - 9. Speaker cable sizes noted are minimum allowed and the contractor shall maintain proper wire size in order to maintain a maximum of 10% voltage drop or 0.5dB insertion loss on any speaker zone. Upsize cables as required to achieve this requirement.
- C. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
 - 1. 12 inches from power lines <5 KVA.
 - 2. 18 inches from high voltage lighting including fluorescent fixtures.
 - 3. 29 inches from power lines of 5KVA or greater.
 - 4. 39 inches from transformers and motors.
- D. Control Circuit Wiring: Install number and size of conductors as recommended by system manufacturing for control functions indicated.

3.4 INSTALLATION

- A. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams. Permanent markers/Sharpies are not allowed for identifying cables or systems.

- C. Equipment Cabinets and Racks:
 - 1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
 - 2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
 - 3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.
 - 4. Label all controls for ease of identification.
- D. Volume Limiter/Compressor: Equip each zone with a volume limiter/compressor. Install in central equipment cabinet. Arrange to provide a constant input to power amplifiers.
- E. Wall-Mounted Outlets: Flush mounted, label all jacks.
- F. Floor-Mounted Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas. Label all jacks.
- G. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.
- H. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.
- I. Speaker-Line Matching Transformer Connections: Match existing paging system input voltage and output taps to match wattage level required based on room size. Please note all 70V systems will need wiring installed in a metallic raceway system.
- J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- K. Provide muting relay and connect to main intercom sound system.

3.5 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Insulate all microphone and 600 Ohm lines from each other and from conduit. Verify that conduits have been mechanical and electrically connected to boxes and grounded. Do not splice lines in conduit.
- E. Do not ground microphone line shields, except at microphone frame and at console input connectors.

- F. Ground other shields of two (2) conductor cables only at one (1) end, as appropriate. Terminate "floating" ends with wedge-on collars, plastic tape or heat shrinkable tubing.
- G. Maintain continuity of shields at all connecting points.
- H. Connect all audio grounds in an equipment rack to common point.
- I. Head end equipment grounds shall be minimum of #6 copper and bonded to nearest telecommunications grounding bar.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing public address and mass notification systems and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
 - 4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
 - b. Repeat test for each separately controlled zone of loudspeakers.
 - c. Minimum acceptance ratio is 50 dB.
 - 5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
 - 6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
 - 7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.

8. Signal Ground Test: Measure and report ground resistance at public address equipment signal ground. Comply with testing requirements specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
 - C. Retesting: Correct deficiencies, revising tap settings of speaker-line matching transformers where necessary to optimize volume and uniformity of sound levels, and retest. Prepare a written record of tests.
 - D. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.
 - E. Public address and mass notification systems will be considered defective if they do not pass tests and inspections.
 - F. Prepare test and inspection reports.
 1. Include a record of final speaker-line matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.
- 3.7 STARTUP SERVICE
- A. Engage a factory-authorized service representative to perform startup service.
 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
 2. Complete installation and startup checks according to manufacturer's written instructions.
- 3.8 ADJUSTING
- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
 - B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
- 3.9 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the public address and mass notification systems and equipment.
 - B. Provide system training for up to eight people. Training shall last at least two hours and be video recorded for the Owner's future use. Training video shall be saved to flash drive; coordinate exact format with Owner. Provide training manual for each person.

END OF SECTION

SECTION 27 53 13

WIRELESS CLOCK SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS AND SCOPE

- A. Work is described as an extension of an existing Primex Wireless Clock System.
- B. Scope of Work:
 - 1. All existing master clocks, secondary clocks are to remain operational. All existing battery operated wireless clocks removed for construction shall be retained and reinstalled once construction has been completed. Furnish and install (2) new D-Cell alkaline batteries in each clock. Clean all clocks. Furnish and install new Primex clocks once existing clock inventory runs out.
 - 2. Expand the existing Primex Wireless Master Clock System using the Primex 72MHz OneVue™ Sync Wireless Clock System with inclusion of new transmitter repeaters for areas without adequate coverage. All existing analog wireless clocks will remain. All new transmitter/repeaters (when specified) will require a network connection.
 - 3. Furnish and install all system equipment, devices, accessories, and material in accordance with these specifications and drawing to provide a complete and operating system.
 - 4. Prior to installation and acceptance of bids, a site signal transmission quality survey must be performed to determine proper transmitter placement, transmitter wattage requirements for complete building coverage and potential need for transmitter/repeaters.
 - 5. All bids shall be based on the equipment as specified herein. The model designations are that of Primex, Inc. No other manufacturers will be considered due to this being an extension of an existing Primex System.
 - 6. System shall include the System Devices
 - a. Transmitter (Existing master)
 - b. GPS Receiver (Existing).
 - c. Analog clocks, battery operated 12" Traditional Series.
 - d. Associated bi-directional/dual sided clock ceiling mounts when specified.
 - e. Software, APPs and programming.
 - 7. All clocks removed and not required to be reinstalled, shall be turned over to the Owner at their discretion; otherwise disposed of per EPA requirements.
 - 8. **Include Inspection of Existing System.**

1.2 RELATED SECTIONS

- A. Division 26 "Electrical, General"
- B. Division 26 Section "Common Work Results for Electrical"

- C. Division 27 Section "Communications Horizontal Cabling"

1.3 REFERENCES

- A. System devices specified shall meet or exceed the requirements of the following:
 - 1. National Fire Protection Association (NFPA): 1. NFPA 70 - National Electrical Code (NEC).
 - 2. Manufacturer Installation and User Guides and online help system.

1.4 DEFINITIONS

- A. This section provides commonly used terms within this specification.
- B. GPS: Global Positioning System, a worldwide system that employs a constellation of satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world's most accurate and reliable time.
- C. NTP: Network Time Protocol, used for synchronizing the clocks on computer networks and devices from either a public server or a separate server on a private local area network.
- D. UTC: Universal Coordinated Time

1.5 SYSTEM DESCRIPTION

- A. System shall operate on a 72MHz frequency. The 72MHz frequency efficiently transmits its signal through common building materials and across longer distances with less interference - ensuring all system devices receive system data updates.
- B. System transmitter shall require a FCC license for operation, resulting in a safe and interference free operation.
- C. Manufacturer shall offer system transmitters with a variety of power output levels to provide coverage for a single building or an entire campus.
- D. System shall wirelessly synchronize clocks, and shall be capable of clock readouts in multiple time zones where desired.
- E. System shall provide a master time source that is transmitted wirelessly from the system master transmitter to secondary system devices. The master time source can either from a system supplied GPS Receiver or from an OWNER defined internal or external NTP server that the master transmitter can access via the OWNER'S Local Area Network (LAN). Up to three designated NTP Servers may be specified to ensure continuity of time synchronization. The master time will be synchronized to UTC.
- F. Hard wiring of system clocks for data communication shall not be required.
- G. System clocks shall automatically adjust for Daylight Saving Time in locations where DST is observed.
- H. Each system clock and other components shall use both precise time and synchronized time.

- I. Digital clocks shall be synchronized to within 10 milliseconds every 10 minutes and the system shall have an internal oscillator that maintains plus or minus four seconds per day between synchronization, so that clock accuracy shall not exceed plus or minus 0.2 seconds.
- J. **Existing** wireless Analog Clocks and **New** wireless analog clocks shall be synchronized to within 10 milliseconds 6 times per day when operating clock strikes 2:01 AM, 6:01 AM, 10:01 AM, 2:01 PM, 6:01 PM, and 10:01 PM, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronization, so that clock accuracy shall not exceed plus or minus 0.2 seconds.
- K. System shall include an internal clock reference so that failure to detect the master time source shall not result in the system clocks failing to indicate time. Additionally, system transmitters shall have an internal battery backup of up to eight hours in the event of a power failure so that settings and the correct master time will be instantly recalled upon restoration of power.
- L. System shall incorporate a "fail-safe" design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.
- M. If a system transmitter stops transmitting valid time signals due to power failure, the system analog clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored for three consecutive days, a clock's second hand will "two-step" as a visual indicator that the signal has been lost. A system digital clock that has not decoded a valid time signal for a three consecutive days will display a visual indicator by flashing its colons continuously until a valid time signal is received. Should clocks lose both power and signal, the clocks will not function.
- N. Clock locations shall be as indicated and existing analog wireless clocks shall be fully portable, capable of being relocated at any time.
- O. System shall allow for a mobile configurator app (available for both iOS and Android) that allows OWNER to on-board a new transmitter and manage transmitter settings.
- P. System transmitters shall be equipped with Bluetooth® low energy wireless technology that allows the devices to send and receive communication to and from the system mobile configurator app.
- Q. System shall include access to the Manufacturer system cloud-based software that allows OWNER to manage and monitor system transmitters and receive remote support services. Optionally, the system transmitters can be set to stand-alone mode, which does not allow for remote support services. A system that requires stand-alone computer-based system software or server hardware for system management or monitoring does not meet the requirements for this specification.
- R. When new system transmitter/repeaters are shown, they shall require connection to OWNER'S existing wired Ethernet network (DHCP or Non-DHCP) to use NTP as its time source and to also send data to and download settings

from the system software. Coordinate all network connections with Owner. Include all costs for connection to the network.

- S. System software and mobile configurator app shall allow for over-the-air (OTA) firmware updates to a system transmitters.
- T. System software shall log, store, and display all operating diagnostic errors received from a system transmitter.
- U. U.S. only: System must operate in accordance with a "Radio Station Authorization", Form FCC 601 – LM, granted by the Federal Communications Commission (FCC). This license will be issued to and held by the end user.

1.6 SYSTEM SOFTWARE

- A. Shall meet the below specifications:
 - 1. Software interface shall allow the OWNER'S system admin user(s) to manage the system components, including: system transmitter settings, reports, alert rules, system-wide user password complexity settings and user session timeout setting, manage system users and grant user access to system data and features.
 - 2. System software shall allow each system user to manage their own system profile, including their log in email address, password, alert notification preferences, and contact settings.
 - 3. System software shall be licensed and delivered via a Software-as-a-Service (SaaS) model and is built-on and powered by Amazon Web Services (AWS).
 - 4. System software shall include and provide all software and transmitter firmware revision updates.
 - 5. Shall not require the installation of on-site system hardware or software, with the exception of the system transmitter devices that transmit data to and download settings from the system software.
 - 6. Shall maintain and store redundant, data backups for up to seven years.
 - 7. Shall allow system users to access system software from a web browser on a mobile or tablet device or computer with an internet connection and does not require the installation of software or other third-party plug-ins or applications.
 - 8. Shall allow OWNER system admin user(s) to grant and control the data and features available to system users.
 - 9. Shall provide a dashboard view that displays the state of system transmitters and a list of system alerts and system notifications.
 - 10. Shall allow each system user to manage their own system profile, including their log in email address, password, alert notification preferences, and contact settings.
 - 11. Shall allow system users to view current and historical data transmitted by system transmitter devices and the settings of system components. The data and settings viewable to a user shall be limited to the role(s) assigned to their system user profile.
 - 12. Shall allow system users to enter comments to transmitter state-change events.
 - 13. Shall allow systems users to customize how data views are displayed within their system user account.

14. Shall allow user-defined reporting; store and present system historical data in the form of system reports. User-defined data shall include the system transmitter devices included in a report, the frequency a report is system generated, and a specific range of data included in a report. System reports shall be displayed in the system software electronically within the interface and allow a system user to print and download reports. System shall also allow report data to be restricted based on the role(s) assigned to a system user.
15. Shall generate alert notifications to system users 24 hours a day, 365 days a year by user's alert preference. User alert preferences option shall include to receive email, text, or voice notifications.
16. Shall allow system users to acknowledge system alerts within the system software or from a voice alert notification. And system shall record and store the history of all alerting data and system user actions.
17. All system user software access sessions between the web browser and the system software shall be encrypted by the HTTPS protocol.
18. Network communication of the system transmitter to and from system software shall be secure and encrypted using the Transport Layer Security (TLS) encryption protocol and Secure Hypertext Transfer Protocol (HTTPS) authentication.

1.7 REGULATORY REQUIREMENTS

- A. Equipment and components furnished shall be of Manufacturer latest model and compatible with the rest of the system.
- B. System shall be installed in compliance with local and state authorities having jurisdiction.
- C. The end user will hold a license, known as a "Radio Station Authorization" granted by the FCC. This license grants the end user protected use for wireless transmission at the designated frequency. This license will designate a unique "call sign" for each end user.
- D. Transmitter and receiver shall comply with Part 90 of FCC rules as follows: This device may not cause harmful interference. This device must accept interference received, including interference that may cause undesired operation. Transmitter frequency shall be governed by FCC Part 90.35. Transmitter output power shall be governed by FCC Part 90 257 (b).

1.8 SUBMITTALS

- A. Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure showing available colors, styles, sizes, and finishes of clocks.
- B. Samples: Submit one specified system device model(s) for approval. Approved sample(s) shall be tagged and shall be installed in the work at location directed.
- C. Manufacturer Instructions: Submit complete installation, set-up and maintenance instructions.

- D. Floor plans indicating the location of system transmitter(s)/repeaters, approved by Manufacturer, and digital clock locations will be submitted to Owner prior to installation.
- E. In accordance with FCC regulations, an application for "Radio Station Authorization" must be filed by the manufacturer prior to use of the equipment. Furnishing the license, or a copy of the application, will confirm that FCC approval has been obtained.
- F. The manufacturer shall submit evidence of application for FCC Radio Station Authorization prior to installing equipment. Furnish the license or a copy of the application for the license, to the Owner/End User prior to operating the equipment. The original license must be delivered to the Owner/End User.

1.9 SUBSTITUTIONS

- A. Substitutions are not allowed due to new transmitter must operate existing Primex wireless analog clocks.

1.10 QUALITY ASSURANCE

- A. U.S. only: Permits: Operating license for the transmitter from the FCC.
- B. Qualifications Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented experience including 10 or more years of experience producing GPS wireless time systems.
- C. Installer: Company with documented experience in the installation of commercial time systems.
- D. Prior to bidding on this project a site survey must be performed to determine proper transmitter and repeater placement and transmitter wattage requirements for full building coverage.

1.11 DELIVERY STORAGE AND HANDLING

- A. Deliver all components to the site in the Manufacturer original packaging.
- B. Packaging shall contain Manufacturer name and address, product identification number, and other related information.
- C. Store equipment in finished building and in unopened packaging until ready for installation.

1.12 PROJECT SITE CONDITIONS

- A. Clocks shall not be installed until painting and other finish work in each room is complete.
- B. Mobile configurator app: installed on a mobile device meeting the App install requirements. Coordinate with the Owner on what personnel will require this App. Install on all devices as directed by the Owner.
- C. GPS Receiver time source: Existing to remain.

1.13 SYSTEM STARTUP

- A. At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all system devices and components are functioning.

1.14 WARRANTY

- A. Manufacturer shall provide a 5-year limited warranty (parts & labor) on system installed.
- B. All other system components (non-Primex) shall have contractor provided 1-year warranty on parts and labor.

1.15 ATTIC STOCK

- A. Batteries: (4) D-Cell Alkaline Batteries.

PART 2 - PRODUCTS

2.1 SECTION INCLUDES

- A. The system and equipment is specified as described in this section.
- B. All bids shall be based on the equipment as specified herein. The model designations are that of Primex.

2.2 MANUFACTURER

- A. System shall be manufactured by:
 - 1. Primex, Inc. 965 Wells St, Lake Geneva, WI 53147 | Phone: (855) 557-0337 | info@primexinc.com | www.primexinc.com

2.3 SYSTEM OPERATION

- A. The system shall perform in the sequence of operation as described below.
 - 1. Install system transmitters and components, including internal or external antenna, and GPS Receiver, network connections as detailed in Manufacturer installation instructions.
 - 2. Configure system transmitter settings through mobile configurator app detailed in Manufacturer instructions.
 - 3. Configure and install system clock devices per model specifications detailed in Manufacturer installation instructions.
- B. Master transmitter operation
 - 1. When power is first applied, it looks for a master time source (first GPS and then NTP). If a master time source is not found, it uses its onboard real time clock (RTC) and continues to search for its master time source. If time source is not found, transmitter is set to a warning state with a time sync failure status, its caution LED status indicator is illuminated, and transmits its state to the system software at its scheduled check-in time (default set to every 5 minutes). If it fails to get time from either

source consecutively for 30 minutes (default), it enters an alarm state and its error LED indicator is illuminated. If the RTC clock is off significantly, the transmitter will report a critical error to OneVue. This will occur only after the first 30 minutes of operation if the RTC continues to be significantly off.

2. GPS Time Source (To be used as secondary time source when NTP is not available): With the transmitter in GPS mode, it powers to a connected GPS receiver mounted with a clear view of the sky. Upon power, the GPS receiver seeks the GPS satellites in orbit to determine position and UTC time. Once the transmitter acknowledges receivable GPS data, it downloads time data and synchronizes its internal master clock to GPS time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock every time it receives valid time data from the GPS.
3. NTP Time Source (To be used as primary time source means): Transmitter connects over the OWNER'S Ethernet to the IP address of the NTP server. This IP address is programmed into the transmitter as part of its setting configuration. Once the connection to the NTP server is acknowledged, it downloads time data and synchronizes its internal master clock to received NTP time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock in this mode once every 5 minutes by system default (end-user setting). Transmitter configuration allows up to three NTP servers for fail-over purposes.

C. Clock operation

1. After initial setup, the clock and/or timer shuts off its receiver. Six times each day an analog clock microprocessor activates its receiver and starting with the stored channel it search for a valid time signal. Every 10 minutes a digital clock/timer activates its receiver and starting with the stored channel search for a valid time signal. If necessary, the clocks will resynchronize to the correct time.
2. If an analog clock has not decoded a valid time signal for three consecutive days, it enters step mode. Low battery voltage is a common cause of the clock to not properly decode a time signal. If a clock goes into step mode, replace its batteries first and then determine if the clock synchronizes to master time source before attempting other troubleshooting methods.
3. If a digital clock has not decoded a valid time signal for three consecutive days, its display colon indicator flashes continuously until a valid time signal is received.

2.4 EQUIPMENT (System will be an extension of an existing system)

- A. The system shall include all equipment as specified.
- B. Supply following transmitter model(s) when specified on drawings:
 1. 1 Watt Main Transmitter with internal antenna, Ethernet Port for NTP and (with GPS). **Existing to remain.**
 2. 1 Watt Transmitter Repeater with internal antenna as required.
- C. Transmitter general specifications

1. User-defined settings (mobile app): Time Zone, Daylight Saving Time bypass option, up to three NTP time sources, Power-on Transmit Schedule, Normal Transmit Schedule, Firmware, and Repeater Channel for a secondary (repeater) transmitter.
 2. User-defined settings (system software): Legacy Clock Time Zone, Alarm Delay, Firmware, Unresponsive Timeout, and Check-in Interval.
 3. Front panel: four LED status indicators (Power, Transmit, Caution, Error) and Bluetooth labeled push-button to pair transmitter with the system mobile configurator app.
 4. Rear panel: Network LAN port (RJ-45 Ethernet, 100/10 Mbps, 802.3 Ethernet), GPS In port (MiniDIN 7-Pin), dry contact closure relay panel (for use with specified Primex products), and pin port to allow end-user connection initiation (check-in) to system software.
 5. Equipped with Bluetooth® low energy (v5) wireless technology to allow pairing with system mobile configurator app for setting management.
 6. An onboard real time clock (RTC) such that failure to receive time from master time source will not disable the operation of the system clocks.
 7. Time zone adjustment for all time zones in the world and includes Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.
 8. Manufacturer or authorized certified installer shall configure the transmitter FCC call sign and RF channel number. These settings are to be predetermined during the FCC licensing process based on system installation location and existing wireless services operating in the area. The OWNER will be required to contact Manufacturer or authorized certified installer if, for any reason, a different broadcast channel is required, since the request would require a modification of the license, requiring approval by the US: FCC. The system OWNER is the sole proprietor of the FCC License and manufacturer or certified installer are acting as agents. Changes to channel or other FCC regulated configuration settings following the installation by the manufacturer or certified installer are the sole responsibility of the OWNER, and should only be done in accordance with FCC regulations. All costs associated with this work, if needed, shall be included as part of this contract.
- D. 1 Watt Main Transmitter specifications (*Existing unit to remain*)
1. Transmitter shall meet the specifications below:
 - a. 1-Watt maximum transmission (at transmitter)
 - b. 72MHz frequency range
 - c. 49 channels available (pre-programmed prior to shipment, channel must be coordinated with existing unit being replaced so as to allow for all existing and new devices operate).
 - d. Dimensions: 17.0"L x 12.0"W x 1.7"D.
 - e. Weight: 9 lb.
 - f. Power Supply: Input: 120 VAC, 50/60 Hz, 0.6 Amp | Output: 9 VDC, 2.78 Amp, 6 ft. cord
 - g. Operating Range: 32° to 122°F.
- E. Internal antenna specifications (1 Watt Transmitter)\
1. Transmitter shall include an internal antenna that is fastened to the top of the unit.
 - a. Antenna: 46.0 in. L.
 - b. Weight: 7.75 lb.

- F. GPS Receiver specifications (Existing devices used as a secondary time source when NTP primary is not available)
1. External Antenna model: GPS roof mounted with 16 ft. cable attached. GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.
 2. An GPS extension cable is available from the Manufacturer, 50 ft., 100 ft., or 200 ft. Use with an external antenna: total GPS cable length cannot exceed 100 ft. Utilize appropriate length as required. Cable shall be plenum rated.
 3. GPS connection to main Transmitter requires ferrite bead connector (supplied with transmitter).
- G. Repeater Transmitter (Secondary) to meet full building coverage requirements.
1. Shall receive signal from master Transmitter and transmit the signal to the system devices in its vicinity, which are out of range from the master transmitter.
 2. This item should only be installed after an on-site signal quality survey/test has been accomplished (prior to bidding) to identify the need for a repeater system.
 3. Repeaters that are required to complete a full clock system coverage shall be included as part of this clock system scope of work. No additional costs shall be incurred by the Owner after award of contract. Include all associated costs for repeater, cabinet, network connections, 120volt power sources, and installation.
- H. Analog Clocks:
1. Clocks shall meet the following specifications. **Type (102-DC110A01), verify with Owner prior to ordering so matches existing type currently being used.**
 - a. Utilizing the power of GPS and Network Time Protocol (NTP), Primex analog clocks perfectly synchronize to improve workflow, accountability, and productivity. They synchronize seamlessly with your 72 MHz system using our proprietary 72 MHz signal that transmits easily through common building materials and across longer distances with less potential for signal interference.
 - b. Durable thermoplastic frames and lenses.
 - c. Automatically adjust for Daylight Saving Time.
 - d. Synchronize via 72MHz technology and GPS or NTP acquired time.
 - e. Power Source – Battery.
 - f. Size: 12.5" Diameter, 2.5" Deep.
 - g. Batteries: Include (2) D-Cell Alkaline Batteries for each clock.
 - h. Dial: Traditional Series style with white face, black numbers, black hour and minute hands and red seconds hand.
 - i. Include clock hanger/bracket and clock locking tab so clock cannot be easily removed.
- I. Accessories (When specified on the drawings):
1. Bi-Directional clock dual mounting brackets.
 - a. The kit includes a bracket, mounting plate, and hardware to easily assemble and install two 12.5" Traditional Series Clocks back-to-back.

- b. Include clock locking tab so clocks cannot be easily removed.
- 2. Transmitter & Transmitter Repeater Rack Mount Kit for 1-Watt Transmitters
 - a. 18 GA metal
 - b. Epoxy coated
 - c. 20"W x (height as required) x 18"D.
 - d. See drawings for additional information on rack type, keep as small as possible to accommodate equipment.
- 3. Description
 - a. 1-Watt Transmitter & Transmitter Repeater Rack.
 - b. Transmitter accessory pack – Include transmitter Rack and APC UPS Smart UPS Lithium-Ion, 120volt, 500VA for each location. If rack is used, use rack mount UPS unit.
 - c. Include 120volt power for all new repeater locations. Connect to nearest power panel and lock out breaker. Label card directory.

PART 3 - EXECUTION

3.1 INSPECTION OF EXISTING SYSTEM

- A. The contractor shall perform an initial system checkout to determine the functionality of the existing clock system. Provide documentation to the Owner identifying any components not currently working or out of manufacturer specifications. If this document is not provided to the Owner prior to the start of work, the contractor is acknowledging that all existing system components are in proper working order, and it will be the contractor's responsibility to make any and all repairs (at their own cost) to the system to return it to a normal operating condition.

3.2 EXAMINATION

- A. Examine conditions with the Installer present for compliance with requirements and other conditions affecting the performance of the system and the system devices.
- B. Do not proceed until unsatisfactory conditions have been corrected.
- C. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.

3.3 INSTALLATION

- A. Include site wireless coverage analysis to verify new transmitter (when specified) and necessary repeaters will capture all new and existing wireless clocks.
- B. General: Install system devices in accordance with applicable codes.
- C. Install system devices in accordance with Manufacturer written instructions.
- D. Provide all system equipment necessary for a complete and operable system.

- E. Comply with requirements of Division 27 Sections "Common Work Results for Communications" and "Communications Horizontal Cabling."
- F. Cables: Install cables in raceways except within consoles, cabinets, and desks and except in accessible ceiling spaces where exposed plenum rated wiring is allowed. Conceal all cabling.
- G. Support all bi-directional digital ceiling mounted clocks from structure above ceiling. Do not rely solely on the ceiling system for support. Utilize Uni-strut and threaded rods as required for a secure installation. All clocks shall be mounted as high as possible to deter vandalism. All locations with low ceilings (below 9'-0") shall have clock positioned at side of corridor and mounted tight to ceiling. Coordinate final location with Architect prior to installation of all clock units.
- H. Include all 120volt power conduit and wiring to new repeater rack locations (when specified) and connect to local power sources as shown on drawings. Include all costs for all 120volt work and coordinate work with Electrical Contractor
- I. GPS Unit (*Existing unit to remain*) (INTERNAL Antenna Transmitter Model only):
 - 1. GPS antenna to be used only as a secondary source of time control. Primary means will be NTP signal.
 - 2. Install GPS unit on roof in location indicated, in clear view of the sky.
 - 3. Install unit in location free from standing water and above accumulations of leaves or debris.
 - 4. Seal cable connection to GPS with cable connection sealant.
 - 5. Any added cable lengths must be protected from outside elements.
- J. If GPS Unit will be used as master time secondary time source when NTP is not available:
 - 1. Attach GPS receiver cable to transmitter back panel.
 - 2. Set GPS/LAN DIP switch to GPS.
- K. When using NTP as master primary time source:
 - 1. When NTP is the master primary time source, the network drop used to connect the transmitter must have connectivity to the NTP server, which can be verified by the Owner's Information Technology department. The default NTP address is time.nist.gov. If the network has a different NTP IP address, it may be programmed into the transmitter by the installer to allow connection to the proper network time.
 - 2. Connect plenum rated CAT6 EIA/TIA standard Ethernet cable from transmitter back panel LAN port to available network drop. Include Network jacks, plenum cabling, J-hooks, faceplate, back box, raceway stubs, patch cords, testing and labeling as part of this work. Connect to nearest MDF/IDF rack. Include up to 100 meters of cable and removal and reinstallation of ceiling systems. All exposed raceways in finished spaces to be of the metallic Wiremold type. When conduit is allowed by the Architect, it shall be painted out to match the area.
- L. Transmitter (INTERNAL Antenna only)

1. Locate transmitter/rack where indicated, a minimum of 2 to 3 ft. above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls.
 2. Transmitter(s) will be placed at locations indicated within specifications and drawings.
 3. Connect antenna to transmitter, using care not to strip threads.
 4. Connect power supply to the transmitter.
 5. Plug power supply into electrical outlet.
- M. Analog Clocks, install new clocks where noted.
1. Perform the following operations with each clock:
 2. Configure and set clock to correct time in accordance with manufacturer instructions.
 3. At each clock, observe clock until valid signals are received and clock adjusts itself to correct time.

3.4 FIELD INSPECTION

- A. Inspection: Make observations to verify that system devices and components are properly labeled.
- B. Prior to final acceptance, inspect each system device and component, adjust as required, and replace parts which are found defective.
- C. At completion of system device installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that the system and all system devices and components are functioning.

3.5 MANUFACTURER SERVICES

- A. System software and device manuals shall be assessable through Manufacturer online knowledge base
- B. Provide Manufacturer system commissioning in accordance with Manufacturer written recommendations. Perform operational testing to verify compliance with requirements. Adjust as required.
- C. Manufacturer to provide a specified level of system commissioning services.
 1. On-site commissioning: system deployment training, software configuration, including system set up, validation of device configuration, system functionality, verification of device network connections, and device install training.

3.6 CLEANING

- A. Prior to final acceptance, clean exposed surfaces of devices, using cleaning methods recommended by Manufacturer.
- B. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.7 DEMONSTRATION (If requested by the Owner)

- A. Provide training to OWNER'S representative on setting, adjusting and configuring device and routine maintenance.
- B. Provide training to OWNER'S representative on how to install or access the system provided software, adjusting and programming the transmitter, setting and adjusting system devices and routine maintenance.
- C. Include minimum of 1 hour of training.
- D. All training to be video recorded and provided in electronic format (flash drive) to the Owner as part of as-built and close out documentation.

3.8 PROTECTION

- A. Protect finished installation until final acceptance of the project.

3.9 TESTING

- A. All devices must be tested at their operational location under normal operational conditions to ensure reception of signal.

3.10 CLOSE OUT DOCUMENTATION

- A. Provide wireless system coverage testing results.
- B. Provide Operations and Maintenance manuals on all parts provided as part of this contract.
- C. Provide system installation As-Builts showing all devices installed including transmitters, repeaters, clocks, power circuits and network cabling locations. Include all IP addresses used for system operation.
- D. Provide recorded system training and sign-in sheet of all who were present.
- E. Provide warranty letters on all equipment and installation.
- F. Provide cut sheets/shop drawings of all approved devices.
- G. Provide system start up and testing certification for all equipment and network cabling test results.
- H. Provide all Close Out Documentation in electronic format (flash drive) and in hard copy format (3 sets) when requested by the Owner and Architect.

END OF SECTION

SECTION 28 05 00

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Electronic safety and security equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electronic safety and security installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security 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 electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels as specified.

- D. Coordinate sleeve selection and application with selection and application of firestopping specified.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products 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.

2.3 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.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment

and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for all penetrations. 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. If above accessible ceiling, sleeves can extend 1 inch out of wall.
- F. Extend sleeves installed in floors to above accessible ceiling.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway. All other sleeves for cabling shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required.
- 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.
- 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.
- 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.

- N. Furnish and install sleeves for all low voltage cabling, including Data, Voice, Video, Intercom, Clock, Thermostat, Fire Alarm, Security, etc. All sleeves shall be provided with end bushing/fitting to protect cabling. Sleeves shall be sized based upon 40 percent NEC fill rate and allow for minimum of 50 percent expansion for future cables. Utilize multiple sleeves as required. Minimum sleeve size is 3/4 inch conduit.

3.3 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.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements as specified.

END OF SECTION

SECTION 28 05 13

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Category-6A UTP cabling.
 - 2. RS-232 cabling.
 - 3. RS-485 cabling.
 - 4. Low-voltage control cabling.
 - 5. Control-circuit conductors.
 - 6. Fire alarm wire and cable.
 - 7. Identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- E. Open Cabling: Passing telecommunications cabling through open space (above accessible ceilings).
- F. RCDD: Registered Communications Distribution Designer.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For cables, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
 - d. Electrical characteristics.
- B. Shop Drawings: Cable layout, showing cable route, with relationship between adjacent structural, electrical, and mechanical elements.
- C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For wire and cable to include in operation and maintenance manuals. In addition to items specified, include the following:
 - 1. Allowable pulling tension of cable.
 - 2. Cable connectors and terminations recommended by the manufacturer.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL – U.L.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of cables for open and short circuits.

1.7 PROJECT CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
 - 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- C. Do not allow cables to be painted.

1.8 WARRANTY

- A. One Year parts and labor unless manufacturer's standard warranty is for greater length of time.
- B. Refer to other Divisions 26, 27 and 28 for additional warranty requirements.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Support of Open Cabling: U.L. labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- B. Cable Trays (when specified on drawings):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cablofil.
 - b. Cooper B-Line, Inc.
 - c. GS Metals Corp.
 - d. Mono-Systems, Inc.
 - e. Panduit.
 - f. Hubbell.
 - 2. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by hot-dip galvanizing, complying with ASTM A 123/A 123M Grade 0.55, not less than 0.002165 inch thick.
 - a. Basket Cable Trays: Dimensions as specified on drawings. Wire mesh spacing shall not exceed 2 by 4 inches.
 - b. Ladder Cable Trays: Nominally 12 inches wide, and a rung spacing of 12 inches. Refer to drawings for additional information.
 - c. All fire alarm cabling to be installed in dedicated raceway.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
- D. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 inches by size required. Comply with requirements for plywood backing panels. Paint out white, do not cover fire label.

2.3 CATEGORY-6A CABLE

- A. Refer to Division 27 Section "Communications Horizontal Cabling" for requirements.

2.4 RS-232 CABLE

- A. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Fluorinated ethylene propylene insulation.

3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Fluorinated ethylene propylene jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.5 RS-485 CABLE

- A. Plenum-Rated Cable: NFPA 70, Type CMP.
 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Overall shielded.
 4. Fluorinated ethylene propylene jacket.
 5. Flame Resistance: NFPA 262, Flame Test.

2.6 LOW-VOLTAGE CONTROL CABLE

- A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Fluorinated ethylene propylene jacket.
 5. Flame Resistance: Comply with NFPA 262.

2.7 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway and power-limited cable, complying with UL 83, concealed in building finishes.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.
- D. All cabling installed in plenum areas will be installed in raceway and will be plenum rated.

2.8 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Comtran Corporation.
 2. Helix/HiTemp Cables, Inc.; a Drake Company.
 3. Rockbestos-Suprenant Cable Corp.
 4. West Penn Wire; a brand of Belden Inc.
 5. Allied Wire and Cable.
 6. Coleman Cable Inc.
 7. Belden Cable.

- B. General Wire and Cable Requirements: U.L. listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair (or as required by Alarm Panel Manufacturer), not less than No. 18 AWG, 300volt rated and as recommended by system manufacturer.
- D. Notification circuits: Solid copper conductors, 2 conductors, not less than No. 16 AWG, 300volt rated and sized for voltage drop so that notification device voltage does not drop below 18volts.
- E. Audio Circuits: Solid-copper conductors, 2 conductors not less than No. 18 AWG, 300volt rated and as recommended by system manufacturer. Size as required to minimize audio circuit voltage drop. Utilize shielded cable when specified by fire alarm panel manufacturer.
- F. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
- G. All fire alarm cabling to be plenum rated and fire protection listed.

2.9 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. HellermannTyton.
 - 3. Kroy LLC.
 - 4. PANDUIT CORP.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables according to TIA/EIA-568-C.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B.

- B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits to above accessible ceiling or to backboards.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards as required. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems." for installation of supports for pathways, conductors and cables.

3.3 WIRING METHOD

- A. Install wiring in metal raceways and wireways. Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Install wiring in raceways except in accessible indoor ceiling spaces. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch. Control and data transmission wiring shall not share conduit with other building wiring systems. All cabling subject to damage (i.e., Gymnasiums, Locker Rooms, Mechanical Rooms, etc.) shall be installed in raceway and shall be painted out to match area.
- C. Install cable, concealed in accessible ceilings, walls, and floors when possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-C.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- D. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
 - 4. **Do not support cables from ceiling grid support wires.**
 - 5. **Do not install cabling above top chord of bar joists or within 6 inches of roof deck to avoid roofing nail damage.**
- E. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.

- c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceway and Boxes for Electrical Systems."
 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 2. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

- E. Cable Taps: Use numbered terminal strips in cabinets, or equipment enclosures where circuit connections are made.
- F. Device wiring: Wire from device to device, no intermediate splices are allowed.
- G. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.6 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.7 CONNECTIONS

- A. Comply with requirements in Division 28 Section "Fire-Alarm and Voice-Notification System" for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in mechanical contractors' specification for Refrigerant Detection and Alarm for connecting, terminating, and identifying wires and cables.

3.8 FIRESTOPPING

- A. Comply with requirements.
- B. Comply with TIA-569-B, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.9 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.10 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect cable jacket materials for U.L. certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-C.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

SECTION 28 31 11

FIRE-ALARM AND VOICE-NOTIFICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, apply to this Section.
- B. Refer to drawings for manufacturer, model numbers and additional requirements.

1.2 SUMMARY

- A. Section includes extension of **Existing Siemens XLS-R** Fire Alarm System.
- B. Section Includes:
 - 1. Existing fire-alarm control unit, including voice evacuation system.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Non-system detectors.
 - 5. Carbon monoxide detectors.
 - 6. Heat detectors.
 - 7. Notification appliances, including audio speakers.
 - 8. Magnetic door holders and/or holder closers.
 - 9. Existing Remote annunciator with voice control kit and control switches.
 - 10. Addressable interface monitor and control devices.
 - 11. Existing radio alarm transmitter
 - 12. Sprinkler system monitoring.
 - 13. Zone Maps.
 - 14. Passcodes.
 - 15. **Inspection of Existing System.**

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.
- C. LCD: Liquid Crystal Display.
- D. AHJ: Authorities Having Jurisdiction.
- E. MNS: Mass Notification System.

1.4 BUILDING CODES AND STANDARDS

- A. The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation

only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.

1. FM Global (Factory Mutual (FM)): FM Approval Guide
 2. National Fire Protection Association (NFPA)
- B. National Fire Protection Association (NFPA):
1. NFPA-70 - National Electrical Code (NEC) 2014
 2. NFPA-72 - National Fire Alarm and Signaling Code - 2013 Edition with Mass Notification
 3. NFPA 720 - Standard for inspection of carbon monoxide detection and wiring.
 4. NFPA 101 - Life Safety Code 2015
 5. IBC - International Building Code 2015
 6. IFC - International Fire Code 2015
 7. IMC - International Mechanical Code 2015
- C. National Electrical Manufacture's Association (NEMA)
- D. Underwriters Laboratories, Inc. (UL)
1. UL-864 - Control Units for Fire Protective Signaling Systems (9th Edition)
 2. UL-268 - Smoke Detector for Fire Protective Signaling Systems
 3. UL-217 - Smoke Detectors for Single and Multiple Station
 4. UL-521 - Heat Detectors for Fire Protective Signaling Systems
 5. UL-464 - Audible Signaling Appliances
 6. UL-1971 - Visual Signaling Appliances
 7. UL-38 - Manually Actuated Signaling Boxes
 8. UL-1480 Standard for Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
 9. UL-1481 - Power Supplies for Fire Protective Signaling Systems
 10. UL 2017 - Mass Notification Systems
 11. UL 2572 - Control and Communication Units for Mass Notification Systems
 12. UL 228 - Door Holding Devices
 13. UL 268A - Smoke Detectors for Duct Application
 14. UL 1283 - Electromagnetic Interference Filters
 15. UL 1449 - Transient Voltage Surge Suppressors

1.5 REGULATORY REQUIREMENTS

- A. All equipment specified shall be UL/FM listed and cross listed for use with the main fire alarm control panel and shall bear the same manufacturer's name on the main control panel as well as all the remote devices. Systems having equipment with various manufacturers' names will not be acceptable. All control equipment shall be listed under UL category UOJZ as a single control unit and also UL/FM listed for power limited applications per NEC 760.

1.6 SYSTEM DESCRIPTION

- A. Non-coded, UL Listed intelligent analog addressable system, one-way digital voice communications with multiplexed signal transmission and survivable network nodes. The entire system shall be UL2572 Listed Mass Notification System.

- B. The System supplied under this specification shall utilize node-to-node, direct wired, multi priority peer-to-peer network operations where network control or remote voice command centers are located on the drawings. The system shall utilize independently addressed, input/output modules, audio amplifiers, and voice communications as described in this specification. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, and LCD panels. Each panel shall be an equal, active functional member of the network, which is capable of making all local decisions and generating network tasks to other panels in the event of panel failure or communications failure between panels. Master/slave system configurations shall not be considered as equals.
- C. The fire alarm equipment and installation shall comply with the current provisions of the following latest edition UL and NFPA standards and shall be listed for its intended purpose and be compatibility listed to insure integrity of the complete system.
- D. The entire system shall be a UL464 Listed Audio Evacuation System. This includes all Control Panels, Remote Command Centers, Remote Microphones, Data Gathering Panels, Network Nodes, all amplifiers and all high fidelity speakers. All of these components shall be UL cross-listed together.
- E. The system performance specified herein is based upon a minimum design performance requirements utilizing high fidelity speakers with the following minimum selectable sound performance levels from 81.5; 84.1; 87.3; and 90.5 dBA (.25, .50, 1.0, 2.0 watts, respectively).
- F. At a minimum, provide at least one (1), One-Way Voice Command Center as noted on the drawings. Each Command Center shall be fully redundant on the network with redundant audio network, audio messages (32 minutes of message storage capacity, minimum), paging microphone and the following:
 - 1. Command Center or Local Operator Console (LOC) with redundant audio messages, paging microphone and request for control switches & status indicators. Each Command Center shall have switches with LED annunciating control and requesting control as follows:
 - a. Request Take Control
 - b. Request Accepted
 - c. Request Deny
 - d. Restore command center to normal operation
 - e. Priority request override Take Control
- G. The Emergency Voice Paging System will provide 8-Channel audio paging up to ten (10) audio paging areas via a system microphone and telephone paging access. The paging system shall be used for routine and emergency paging.
 - 1. Area 1 – Interior Areas/By Floor
 - 2. Area 2 – Exterior Areas
 - 3. Area 3 – To Be Determined By Owner
- H. Provide telephone access paging interface selectable with ten paging areas, plus all call.
- I. All remote local operating console (remote annunciator/LOC) shall have LCD display, paging microphone, audio zone selection switches and by-pass switches. Provide visual indication which microphone is active during paging

operations. During local microphone paging the speakers located near by the microphone shall be muted through software programmable audio control relays. The LOC shall not override the Command Center operations.

- J. The fire alarm equipment and installation shall comply with the current provisions of the following latest edition standards (unless otherwise noted below) applicable to the jurisdictional authorities, including their local adoptions and amendments and it shall be listed for its intended purpose of a Mass Notification and Emergency Communication Signaling System and be compatibility listed to insure integrity of the complete system. It shall be listed to all of the UL Standards listed herein, without exception.

1.7 SUBMITTALS

- A. The Contractor shall not purchase any equipment for the system specified herein until the Owner and/or designated representative has approved the project submittals in their entirety and has returned them to the contractor. It is the responsibility of the contractor to meet the entire intent and functional performance detailed in these specifications. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications. The Contractor shall submit three (3) complete sets of documentation within 30 calendar days after award of purchase order.
- B. Each submittal shall include a cover letter providing a list of each variation that the submittal may have from the requirements of the Contract Documents. In addition the Contractor shall provide specific notation on each Shop Drawing, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.
 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Architect.
 2. Provide shop drawings and battery calculations to local fire department.
 3. Technical Submittals including Engineered Fire Alarm Installation layout Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Registered Professional Fire Protection Engineer which is a Licensed Professional Engineer who has passed the NCEES Principles and Practices of Fire Protection Engineering Examination licensed in the state which has jurisdiction.
 - b. NICET Level IV technician who has been certified at Level IV in the sub-field of Fire Alarm Systems Layout.
 - c. Submittals shall also include the Quality Assurance certifications of the Fire Alarm Technician (see Paragraph Section 1.8).
 - d. Distributor Qualifications: Provide documentation of the independently owned, Fire Alarm Distributor's qualifications, including all licenses, certificates and proof of authorization as a Manufacturer's Representative in Good Standing.
- C. Product Data: Product Data sheets with the printed logo or trademark of the manufacturer of all equipment. Indicated in the documentation shall be the type, size, rating, style, and catalog number for all items proposed to meet the

system performance detailed in this specification. The proposed equipment shall be subject to the approval of the Owner.

- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Comply with all recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72.
 2. Include voltage drop calculations for notification appliance circuits based on manufacturer-provided panel start voltage and point-to-point notification appliance circuit calculations. System Layout drawings prepared using the Lump Sum Method for visual strobe circuits are not acceptable.
 3. Include battery-size calculations. Batteries shall include a 30% safety factor above the minimum requirements derived from calculations, as required by NFPA 72.
 4. Power supplies shall be sized to furnish the total connected load in a worse-case condition, plus 30 percent spare capacity for future growth.
 5. Include fire alarm plans (drawings to scale in AutoCAD format), riser diagrams, point-to-points showing all devices and locations of all end of line resistors.
 6. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 7. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors in accordance with NFPA 72.
 8. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 9. Indicate speaker wattage tap settings for all speakers on the floor plans, calculate and show dB Line Loss calculations for all speaker circuits using the Lump sum method. dB Losses shall be no greater than 3.0 dB from amplifier start terminals to last device.
 10. Indicate all Acoustically Distinguishable Areas on the installation shop drawings.
 11. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits from end-to-end. "Home Run" indicators or other non-end-to-end wire path designations are not acceptable.
 12. Include programming matrix for all devices showing input and output functions. Air handler shut down of each unit as required based on local alarm.
- E. Operation and Maintenance Data: For fire-alarm systems and components to be included in emergency, operation, and maintenance manuals. In addition to items specified, include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA72.

2. Provide "Record of Completion Documents" according to NFPA72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software database file, hardcopy printout and CD, with password for delivery to the owner. Proprietary system/service companies will not be acceptable.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals (hardcopy) and electronic on CD.
 - e. Include every device in the system and associated print out showing each device as Passing or Failing tests.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 7. Copy of NFPA 25 results.
- F. Software and Firmware Operational Documentation:
1. CD of site-specific software database file with password and all product data sheets. Provide hard copy printout of the software program. Single Source Providers or Proprietary System/service companies will not be acceptable.
 2. Provide a list of global system settings.
 3. Provide a list of the contents of each system cabinet and their settings.
 4. Provide a list of all addressable devices with their addresses and settings.

1.8 QUALITY ASSURANCE

- A. Fire Alarm vendor's employed personnel shall be trained and certified by the manufacturer (an authorized Siemens Dealer with direct ties to the manufacturer) on the make and model of the fire alarm control panel specified for this Project. *All installers without this certification will have their bids rejected unless they receive prior approval from the Owner, Architect and Engineer in writing.*
- B. The following is a list of pre-approved vendors capable of bidding and working on this project. All other bidders will need to be pre-approved by the Owner, Architect and Engineer prior to bidding:
 1. **For system upgrades, parts and installation contact Brian Schmid at First Security, 1811 High Grove, Suite 191, Naperville, IL 60540, 630.961.5900. b.schmid@first-sec.com**
 2. **For system programming, contact Stephen Hupp at Fire Safety & Security Life Cycle Sales Executive Siemens Smart Infrastructure, 585 Slawin Ct., Mount Prospect, IL 60056, 847.217.7509.**
- C. Installer Qualifications: Fire Alarm distributor's employed personnel shall be trained and certified by manufacturer (an authorized Siemens Dealer with

direct ties to the manufacturer) on the make and model of the fire alarm control panel specified for this Project.

- D. Additional Installer Qualifications: Installation shall be by personnel certified by NICET as a technician who has been certified at Level II in the sub-field of Fire Alarm Systems Layout.
- E. Project Manager Qualifications: Installation shall be supervised by personnel certified by NICET as Fire Alarm System Layout Level IV Technician (SET), an NFPA Certified Fire Protection Specialist (CFPS) or an NCEES accredited Licensed Fire Protection Engineer (FPE).
- F. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single distributor and manufacturer. Components shall be compatible with, and operate as a fully U.L. listed extension of a U.L. 864 listed fire alarm control system.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, by a qualified testing agency, and marked for intended location and application.
- H. Fire Alarm Distributor Qualifications:
 - 1. Contractor shall utilize an Illinois Licensed Private Alarm Contractor Agency that is an authorized, independently owned Manufacturers representative of the specified fire alarm equipment manufacturer.
 - 2. Fire Alarm Distributor shall be a full service entity qualified to provide the engineering for the technical submittal, furnishing of the equipment, commissioning, testing and inspection services outlined herein including intelligibility testing and capable of providing full repair service to any fire alarm system and/or provide fire alarm system installation and design including, but not limited to, the following minimum requirements:
 - a. Qualified Fire Alarm Service Company with employees who meet the criteria defined by NFPA 72 for the qualifications of both System Designers and System Installers to include the requirements of the Authorities Having Jurisdiction (AHJ).
 - b. Certified Fire Alarm Service Inspectors with employees of the entity who are certified in Fire Protection Engineering Technology by the National Institute for Certification in Engineering Technologies (N.I.C.E.T.) in FIRE ALARM SYSTEMS – LEVEL II, minimum.
 - c. Five (5) Years of experience with intelligibility measurement technology and testing (minimum) is required for this project and the Fire Alarm Distributor shall provide intelligibility measurement equipment capable of registering and recording Intelligibility readings in accordance with IEC 60268-16, Sound System Equipment - Part 16: Objective Rating of Speech Intelligibility by Speech Transmission Index. Equipment shall have been calibrated within one (1) year of the commencement of the intelligibility testing for this project.
 - 3. Distributor shall be a registered Illinois legal entity (Corporation, Partnership, Professional Corporation or Limited Liability Company) in Good Standing with the Secretary of State of Illinois.

4. Distributor entity shall hold a valid Illinois Private Alarm Contractor Agency License. Sub-contractors or licensed individual Private Alarm Contractors DO NOT meet this requirement.
 5. Distributor entity shall be qualified by the AHJ, including the Illinois Department of Professional Regulation to provide engineering design services for a fire alarm and mass notification system as evidenced by holding an Illinois Registered Professional Design Firm license. Sub-contractors or individually licensed individual Registered Architects, Professional or Structural Engineers DO NOT meet this requirement.
 6. All service employees of the entity shall have a valid Illinois Permanent Employee Registration Card (P.E.R.C.).
- I. Contractor must inspect the buildings and become familiarized with building construction prior to submitting their bid.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
1. Notify Architect, Construction Manager and Owner no fewer than seven (7) days in advance of proposed interruption of fire-alarm service.
 2. Do not proceed with interruption of fire-alarm service without Architect's, Construction Manager's and Owner's written permission.

1.10 INSPECTION OF EXISTING SYSTEMS

- A. The contractor will be responsible for inspecting all existing systems that will be worked on (during the course of the construction project) before touching them. This shall cover, but not limited to the following systems: fire alarm system). This inspection will need to document any issues with the existing systems that are affecting their proper operation. If this report is not provided, the contractor is attesting that all systems were functional and properly operating before the start of the construction and will be responsible for all repairs. The onus is on the contractor to identify problems with any of the systems to the Owner prior to construction.

1.11 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. The contractor will maintain an operational fire alarm system throughout the course of construction. Systems can be taken out of service on non-school days or after business hours when working in the building, but must be put back into service when building is left unoccupied. If for whatever reason this process cannot be done, **the contractor will be required to hire a fire watch person that has been approved by the Fire Department to monitor the**

building when it is left unprotected. Refer to drawings for additional information.

- C. The contractor will be required to acknowledge when they take system out of service and when they restore system service each day. Provide fire alarm clip board next to fire panel and identify date, time and person performing this work for record. All actions must be coordinated with the Owner, no exceptions.

1.12 DELIVERY, STORAGE AND HANDLING

- A. Store all devices in a clean, dry, heated space.
- B. After installation, protect equipment from damage by work of other trades.

1.13 PROTECTION/CLEANING

- A. Provide dumpster for all removed equipment at contractor's expense.
- B. Protect all areas working in. Provide tarps to cover all floors and equipment to avoid damage. Provide hard boards to cover specialized flooring areas such as Gymnasiums, Multi-Purpose Rooms, Cafeterias, etc., to prevent damage/scratches to special surfaces. Thoroughly clean and vacuum all areas that work has been completed in.

1.14 ACCESSIBILITY

- A. Provide appropriate lifts and ladders to reach specified work. Do not use the Owner's equipment and supply.

1.15 WARRANTY and SOFTWARE SERVICE AGREEMENT

- A. The contractor shall warranty all materials, installation and workmanship for one (1) year from date of acceptance, and all Fire Alarm Equipment Component materials. Manufacturer material warranties for more than one year shall remain in force. A copy of the manufacturer's warranty shall be provided with closeout documentation and included with the operation and installation manuals.
- B. The System Supplier shall maintain a service organization with adequate spare parts stocked within 75 miles of the installation. Any defects that render the system inoperative shall be repaired within 4 hours of the Owner notifying the contractor.
- C. Technical Support: Beginning with Substantial Completion, provide software support for one (1) year, shall be included in this project.
- D. Detector Sensitivity Testing: During the warranty period, each year the contractor is to perform detector sensitivity testing and provide report to the Owner. Unless, the system is UL Listed to perform automatic sensitivity testing without any manual intervention and should detector fall outside of sensitivity window, the system will automatically indicate a devices trouble. A copy of UL letter is to be provided as proof of system operation.

- E. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within one (1) year from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.16 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. Provide quantity equal to 2% percent of amount of each type installed, but no less than one (1) unit of each type.
 - a. Smoke Detectors, heat detectors, carbon monoxide detectors, manual pull stations, duct smoke detector, monitor modules and control modules:
 - b. Notification appliances; speakers, speaker-strobes and strobes.
 - 2. Keys: The installing contractor shall collect all equipment spare keys provided with each lockable or resettable device/cabinet and shall turn all of them over to the Owner at completion.
 - 3. Owner's Stock shall not be used for warranty service.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (SYSTEM IS BASED ON AN EXISTING SIEMENS XLS-R)

- A. Manufacturers: The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling fire alarm system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- B. The Contractor shall provide, from the manufacturer's current product lines, equipment and components, which comply, with the requirements of these Specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.
- C. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building Owner. All specified operational features must be met without exception.
- D. All control panel assemblies and connected (new) field appliances shall be provided by the same System Supplier, and shall be designed and tested to ensure that the system operates as specified. All equipment and components shall be installed in strict compliance with the manufacturer's recommendations.

- E. Approved Products: All panels and peripheral devices shall be of the standard product of single manufacturer and shall display the manufacturer's name of each component. The catalog numbers specified under this section are those of Siemens Systems, and shall constitute the type, product quality, material and desired operating features necessary for the completion of this projects intended design and function.

2.2 MANUFACTURER'S SERVICES

- A. The following supervision of installation shall be provided by a trained service technician who is employed by the manufacturer of the fire alarm equipment. The technician shall be UL and NICET Level III certified and have had a minimum of two (2) years of service experience in the fire alarm industry. The technician's name shall appear on equipment submittals and a letter of certification from the fire alarm manufacturer shall be sent to the project engineer. The manufacturer's service technician shall be responsible for the following items:
 - 1. Pre-installation visit to the job site to review equipment submittals and verify method by which the system should be wired.
 - 2. During job progress, make periodic job site visits to verify installation and wiring of system.
 - 3. Upon completion of wiring, final connections shall be made under the supervision of this technician and final checkout and certification of the system.
 - 4. At the time of final checkout, technician shall give operational instructions to the Owner and/or his representative on the system.
- B. All job site visits shall be dated and documented in writing and signed by the electrical contractor. Any discrepancies will be noted on this document and a copy kept in the system job folder which will be turned over to the project engineer any time during the project.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

- A. Mass Notification initiated event shall override any event and take the highest system priority.
- B. Fire-alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Beam detectors.
 - 4. Smoke detectors.
 - 5. Carbon monoxide detectors.
 - 6. Duct smoke detectors.
 - 7. Verified automatic alarm operation of smoke detectors.
 - 8. Automatic sprinkler system water flow.
 - 9. Heat detectors in elevator shaft and pit.
 - 10. Fire-extinguishing system operation.
- C. Fire-alarm signal shall initiate the following actions where applicable to this facility and jurisdiction:

1. Activate multiple channel pre-recorded voice messages preceded and followed by temporal tone.
 2. Continuously operate the visual notification appliances.
 3. Display Fire Alarm Message Type on Intercom Systems' Digital Display Message Boards.
 4. Identify alarm at fire-alarm control unit and remote annunciators.
 5. Transmit an alarm signal to the remote alarm receiving station.
 6. Unlock electric door locks in designated egress paths.
 7. Release fire and smoke doors held open by magnetic door holders.
 8. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
 9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 10. Recall elevators to primary or alternate recall floors.
 11. Activate emergency shutoffs for gas and fuel supplies.
 12. Record events in the system memory.
 13. Record events by the system printer (if shown or called for in the contract documents).
- D. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Low-air-pressure switch of a dry-pipe sprinkler system.
 3. Elevator shunt-trip supervision.
 4. Duct smoke detector activation.
 5. Carbon monoxide detection, special dedicated CO Supervisory Indication.
- E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging circuitry
 8. High or low battery charge.
 9. Abnormal position of any switch at fire-alarm control unit or annunciator.
 10. Fire-pump power failure, including a dead-phase or phase-reversal condition.
 11. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system.
- F. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer if specified.
- 2.4 FIRE-ALARM CONTROL UNIT (EXISTING TO REMAIN)
- A. The existing main control panel or remote control panel(s) shall be a multi-processor based networked system designed specifically for detection, and one-

way emergency audio communications applications. The control panel(s) shall be listed and approved for the application under the standard(s) as listed. The existing control panel is model **Siemens XLS-R**

- B. The control panel(s) shall include all required hardware, software and site-specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified using software provided by a single supplier. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.
- C. The network of control panels shall include the following features.
1. Ability to download all network applications and firmware from the configuration computer on the network or at any control panel (network node) location.
 2. Each control panel (network node) shall have an LCD display with common controls. The display shall be configurable to display the status of any and all combinations of alarm, supervisory, trouble, monitor, or group event messages.
 3. From each LCD display on the system shall be capable of being programmed for control functions of any node or the entire network. The LCD display shall reside on the network as a node and continue to operate with fault on the network. An LCD can be programmed to be only operation when a node is operational in stand-alone mode, with a network fault.
 4. The system program shall have a minimum of 100 system definable Service Groups to facilitate the testing of installed system based on the physical layout of the system. Service groups that disable entire circuits serving multiple floors or fire zones shall not be considered as equal.
 5. Advanced Windows based programming with Program Version Reporting to document any and all changes made during system start-up or system commissioning. Time and date stamps of all modifications made to the program must be included to allow full retention of all previous program version data. The operator display shall clearly identify unacknowledged and acknowledged alarm, supervisory, trouble, and monitor status messages. The system shall provide the ability to download data from the analog/addressable detectors to a PC while the system is on-line and operational in the protected premises. The downloaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.
 6. Provide system reports that list a detailed description of the status of system parameters for corrective action or for preventive maintenance. Reports shall be displayed on the operator interface or be capable of being sent to a printer.
 7. Provide an authorized operator with the ability to operate or modify system functions such as system time, date, passwords, holiday dates, restart the system and clear the control panel event history file.
 8. Provide an authorized operator the ability to perform test functions within the installed system.
 9. Supervision of system components, wiring, initiating devices and software shall be provided by the control panel. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display. Software and processor operation shall be independently

monitored for failure. The system shall provide fail-safe operation, with multiple-levels of system operation.

- D. Each network control panel shall be capable of:
1. Supporting up to 1500 intelligent analog/addressable points.
 2. Supporting up to six (6) intelligent addressable loops, each loop supporting detectors and modules, total of 250 points.
 3. Supporting network connections up to 64 other control panels and 30 annunciators.
 4. Support up ten network digital dialers with Contact ID or SIA format and TAP Pager protocol.
 5. Supporting multiple RS-232 communication ports and protocol.
 6. Supporting up to 1100 chronological history events.
 7. Total network response shall not exceed 3 seconds.
- E. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, monitor, trouble and component status messages and control menu.
1. The common control switches and with corresponding LEDs provided as minimum will be; Reset Alarm Silence, Panel Silence, and Drill. It shall be able to add additional switches/LEDs as required.
 2. The main control panel shall have display that is 24 lines by 40 character graphic LCD and backlit when active, 960 characters.
 3. Provide 8 simultaneous events to be displayed. The first seven (7) highest priority events in addition to the most recent event. The events shall be automatically placed in event types (Alarm, Supervisory, Monitor & Trouble) for easy access and shall be possible to view the specific event type separately. Having to scroll through a mixed list of event types is not acceptable.
 4. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
- F. Audio One-Way Voice Communication & Amplifier Performance Requirement
1. The voice communication system shall be an eight (8) channel capable audio evacuation system, to allow the ability to have eights simultaneous announcements/paging. The audio channels shall be design as such (coordinate with Owner):
 - a. Mass Notification Message (HIGHEST PRIORITY)
 - b. Fire Message
 - c. Alert Message
 - d. Stand-by Message
 - e. Elevator Message
 - f. Stairwell Message
 - g. Security/Weather Threat
 - h. Manual Paging
 2. The system custom digital voice message shall be created as a .wav file format. All messages shall be able to be created on-site without any special tools or burning of chips. Provide as minimum one twenty (20) watt supervised audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall

automatically provide an internally generated local 3-3-3, 1000 Hz temporal pattern output upon loss of the audio signal from the one-way emergency audio control unit, during an alarm condition.

a. List of Potential Recorded Messages to Use (Utilize existing voice messages already recorded on the system) The following are examples only:

- 1) Fire Alarm (Automatic and Pre-Recorded)
 - a) Tone Type: Three Pulse Temporal (NFPA 72, A.18.4.2.1)
 - b) Tone Cycles: 2 times before and after message (NFPA 72, 24.4.2.17.1)
 - c) Tone Duration: Per NFPA 72, 18.4.2.1
 - d) Message Content: "May I have your attention please. A fire emergency has been reported in the building. Please walk to the nearest exit and leave the building."
- 2) Building Emergency (Evacuate)
 - a) Tone Type: Chime (NFPA 72, A.18.4.2.1(b))
 - b) Tone Cycles: 2 times before and after message (NFPA 72, 24.4.2.17.1)
 - c) Tone Duration: Per NFPA 72, A.18.4.2.1(b)
 - d) Message Content: "May I have your attention please. An emergency has been reported in the building. Please walk to the nearest exit and leave the building."
- 3) Area Emergency (Shelter-in-Place)
 - a) Tone Type: Chime or 1000 Hz tone
 - b) Tone Cycles: 2 times before the message only
 - c) Tone Duration: 3 seconds
 - d) Message Content: "May I have your attention please. An emergency has been reported in the area. Please remain in the building and await further instructions."
- 4) Severe Thunderstorm Warning
 - a) Tone Type: Chime or 1000 Hz tone
 - b) Tone Cycles: 2 times before the message only
 - c) Tone Duration: 3 seconds
 - d) Message Content: "May I have your attention please. The National Weather Service has issued a SEVERE THUNDERSTORM WARNING for this area; please take immediate shelter indoors."
- 5) Tornado Warning
 - a) Tone Type: Chime or 1000 Hz tone
 - b) Tone Cycles: 2 times before the message only
 - c) Tone Duration: 3 seconds
 - d) Message Content: "May I have your attention please. The National Weather Service has issued a TORNADO WARNING for this area; please take immediate shelter in the tornado shelter, basement, or on the lowest level at the center of the building away from exterior windows and doors."
- 6) Test
 - a) Tone Type: Chime or 1000 Hz tone
 - b) Tone Cycles: 2 times before and after the message

- c) Tone Duration: 3 seconds
 - d) Message Content: "May I have your attention please. This is a test of the building mass notification system. Please continue your normal duties. This is only a test."
 - 7) All Clear
 - a) Tone Type: Chime or 1000 Hz tone
 - b) Tone Cycles: 2 times before and after the message
 - c) Tone Duration: 3 seconds
 - d) Message Content: "May I have your attention please. An all clear has been issued; resume normal activities."
 - 8) Microphone (LOC or ACU) Keying
 - a) Tone Type: Chime or 1000 Hz tone
 - b) Tone Cycles: Once
- 3. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall be a supervised, dedicated, selectable 25Vrms output.
- 4. Provide a standby audio amplifier per node that will automatically sense the failure of any primary amplifier installed in the same panel and replace the function of the failed amplifier (One for All Backup).
- 5. Amplifier Minimum Sizing Specification shall be as follows:
 - a. 7.5 Watts per Trumpet Type Loudspeaker
 - b. 2 Watts per 8 inch cone type speaker
 - c. 1 Watts per 4 inch cone type speaker
 - d. 4 Watts per re-entrant horn-driver type speaker
 - e. Plus 30% spare capacity for each connected amplifier or speaker signal circuit switching module.
- G. Provide an Emergency Voice Communication System with the following design features:
 - 1. An audio control unit with Microphone for Paging.
 - 2. Provide 3-position switch for each evacuation signaling zone and "All-Call", with "Page FIRE", "Auto" and "Page ALERT" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow.
 - 3. These LED's shall illuminate to indicate respectively:
 - a. Evacuation signals activated (red).
 - b. Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).
- H. Provide 2-position switch for manually activate pre-recorded voice messages, with "Message Name" positions identified and one LED status indicators, one red. Provide minimum of 12 selector switches.
 - 1. These LED's shall illuminate to indicate respectively:
 - a. Message activated (red)
- I. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions
- J. Circuits Requirements:
 - 1. Signaling Line Circuits for Network Communications:
 - a. Class A, Level 1, pathway survivability level

2. Ethernet IP Network
 - a. Class C, Level 1, pathway survivability level
 3. Signaling Line Circuits for Intelligent Analog Addressable Loop:
 - a. Class A, Level 1, pathway survivability level
 - b. No more than 100 detectors or 100 modules installed on a loop.
 4. Initiating Device Circuit:
 - a. Class A, Level 1, pathway survivability level
 5. Notification Appliance Circuits:
 - a. Class A, Level 1 pathway survivability level
 - b. Maximum circuit loading to 2.25 amps for each 3.0 amp visual circuit, not to exceed 75% of the visual circuits terminal capacity or the power supplies total amperage rating (i.e. no more than 6.0 amps on an 8.0 amp power supply)
 6. Door Holder Circuits
 - a. Class D, Level 1, pathway survivability level
 7. Activation of alarm notification appliances, smoke control, elevator recall and other functions shall occur within 3 seconds after the activation of an initiating device.
- K. Smoke-Alarm Verification:
1. Initiate an audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate a UL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Record events by the system memory.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
 6. Coordinate final decision and program feature requirements with Fire Departments and Owner.
- L. Elevator Recall:
1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
 3. Heat detector and water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
 4. Contractor shall hire Owner's elevator company for making all necessary connections for a complete operating system. All costs to be covered by the contractor and included in bid.

- M. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- N. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change to alternate settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values.
- O. Radio Alarm Transmitter (EXISTING TO REMAIN)
 - 1. New fire alarm radio transmitter will be utilized. Connect to new fire alarm control panel as required.
 - 2. Transmitter shall comply with NFPA 1221 and shall be listed and labeled by U.L./F.M.
 - 3. Comply with 47 CFR 90.
 - 4. Description: Manufacturer's standard commercial product; factory assembled, wired, tested, and ready for installation and operation.
 - a. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
 - b. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
 - c. Normal Power Input: 120-V ac from emergency power panel on emergency generator.
 - d. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
 - e. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mph with a gust factor of 1.3 without failure. Remote mount antenna as required for best reception. Coordinate final location with Owner/Engineer.
 - f. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance. Install in conduit.
 - g. Antenna-Cable Connectors: Weatherproof.
 - h. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
 - 5. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:
 - a. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.

- b. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
 - c. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
 - d. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
 - e. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
 - f. Local Fire-Alarm-System Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.
- 6. Test available signal strength and provide written report prior to ordering unit. If signal strength is unsatisfactory, another communication method will be required at contractor's expense; i.e., digital communicator and phone lines.
 - 7. Connect radio to fire alarm control panel so that when unit fails (power loss, communication failure), there is on-site trouble notification at control and annunciator panels. All new radios shall be provided with auxiliary contacts as required.
 - 8. Contact Fire Department/Central Station for purchasing and setting up new Keltron/AES radio. Coordinate with Owner to complete all documentation/paperwork for setting up account. Contractor shall pay for two years of monitoring service, installation, and set up fees. Owner to fill out all documents and contractor to pay monitoring company.
 - 9. Contractor is responsible for all work associated with Radio and Programming via the Central Station.
- P. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, shall be powered by nominal 24-V dc source. Obtain 120-V power from emergency power panels on generator. Lock out circuit breakers.
 - Q. Test system and certify that central station is capable of receiving signals. Radio shall be supervised and monitored locally for trouble at both fire alarm control and annunciator panels. Radio must transmit for alarm, trouble, supervisory, and carbon monoxide supervisory.
- 2.5 EXISTING REMOTE ANNUNCIATOR WITH ONE-WAY VOICE COMMUNICATION (FAAP) and EXISTING LOCAL OPERATOR CONSOLE (LOC)
- A. Existing annunciator matches those of fire-alarm control unit LCD display functions for alarm, supervisory, monitor and trouble indications and common system controls including; acknowledging, silencing, resetting, and testing. The fire alarm bypass function switches and LCD Keypad may be housed separately in a locked enclosure to prevent unauthorized use and control of fire alarm system program control and bypass, but the Paging Microphone, Audio

Selector and Message Selector Switches shall be housed in a listed enclosure which is capable of being fitted with an unlocked latching knob for the enclosure, such that these emergency communication and signaling controls are readily accessible for emergency signaling. (LOC) Panel to include annunciator/control switches and microphone only. The Contractor shall verify this feature with Owner prior to ordering equipment.

1. This display is a Siemens Annunciator with Switch Modules Series, cabinet size as needed including trimplates, and shall have the following minimum features:
 - a. LCD Display
 - b. Paging Microphone
 - c. Audio Selector Switches
 - d. Audio Message Selector Switches
 - e. System Bypass Switches
2. Utilize pre-finished cabinets when surface mounting is required.

2.6 NAC POWER SUPPLY

- A. The NAC power supply shall be independent unit that will provide power to visual strobe notification appliances. It shall be possible to configure the NAC's to follow the main panel's NAC or activate from intelligent synchronized modules. The booster NAC's must be configurable to operate independently at any one of the following rates: continuous synchronized, or 3-3-3 temporal. Fault conditions on the power supply shall not impede alarm activation of host NAC circuits or other power supplies. The NAC power supply must be able to provide concurrent power for notification devices, security devices, access control equipment and auxiliary devices such as door holders. . All the NAC Power Supplies shall be supervised and synchronized. The power supply shall support up to 24 amp hour batteries.
 1. Power supply shall be minimum of 8 amps and UL 864 Listed.
 2. Four independent 3.0 amp NAC circuits. Each being configurable as auxiliary power.
 3. All circuits shall be synchronized.
 4. Do not exceed 70 percent (70%) of each circuits rating so as to provide future capability. Minimum 30 percent (30%) spare capacity.
 5. Obtain 120 V power from emergency power panels (on generator power if available). Lock out circuit breaker.
 6. Do not mount above ceilings. Locate in equipment closets.
 7. Install smoke detector at this location for protecting unit or other detection device suitable for the application.
 8. Secondary power shall provide 60 hours of standby power in non-alarm state (24 hours if backed up by emergency generator) with 2 hours of emergency system operation or 15 minutes of evacuation alarm at maximum load.

2.7 INTELLIGENT ANALOG SYSTEM SMOKE, HEAT AND CARBON MONOXIDE DETECTORS (*MUST CONFORM TO UL 268, 7TH EDITION*)

- A. General Requirements for Intelligent Analog Detectors
 1. Integral Microprocessor: All decision are made at the detector determining if the device is in the alarm or trouble condition.

2. Automatically updates historic information including hours of operation, last maintenance date, number of alarms and troubles, time of last alarm¹ and analog signal patterns for each sensing element just before last alarm.
 3. Field Replaceable Smoke Sensing Chamber: Analog detectors must have a modular, removable smoke sensing chamber which can be removed for easy cleaning and/or convenient, cost effective service replacement without removing the detector base or resetting the device address, without removal of detector electronics and without requiring any system or device programming adjustments which necessitate a system re-test.
 4. It shall be possible to address each intelligent module using rotary switches.
 5. Automatic Device Mapping: Each detector transmits wiring information regarding its location with respect to other devices on the circuit, creating an As-Built wiring diagram. This will also provide enhanced supervision of the device physical location and the device message shall reside with the location and not the device address. Devices installed in the wrong location will always report the correct message of the physical location.
 6. Sensitivity Range: Each analog addressable smoke detector's sensitivity shall be capable of being programmed individually as: most sensitive, more sensitive, normal, less sensitive or least sensitive. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. It shall be possible to program control panel activity to each level.
 7. Pre-Alarm: Detector stores 20 pre-alarm sensitivity values to alert local personnel prior to the sensor reaching a full evacuation sensitivity. Sensitivity values can be set in 5% increments.
 8. Environmental Compensation: The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be compared against its reference value. The detector shall provide a maintenance alert signal when the detector reaches 75% (Dirty) to 99% (More Dirty) compensation has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.
 9. Twin Status LEDs: Flashing Green LED shows normal; flashing RED shows alarm state; steady RED and steady GREEN show alarm state in stand-alone mode, visible from any direction.
 10. UL Sensitivity Testing: The detector shall utilize a supervised microprocessor that is capable of monitoring the sensitivity of the detector. If the detector sensitivity shifts outside of the UL limits, a trouble signal is sent to the panel.
 11. Device Replacement: The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.
- B. Intelligent Photoelectric Detector

1. Provide intelligent analog addressable photoelectric smoke detectors at the locations shown on the drawings.
- C. Intelligent CO (Carbon Monoxide) Detector.
1. Where called for on the contract drawings, provide intelligent CO sensor at locations shown on the drawings. The CO sensor (or combination type sensor) shall reside on the Intelligent Addressable loop with its unique system identifier and be able to be programmed as Alarm, Supervisory or Monitor.
 2. CO sensor shall be capable of detecting carbon monoxide from any source of combustion and analyzes the sensor data to determine when to initiate a life safety CO alarm. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.
 3. The CO element shall have minimum of six year life span and be field replaceable element without. The CO element shall be factory calibrated.
 4. The CO end of life shall be supervised / monitored by the Control Panel to annunciate end of life. Also, the control panel shall provide a system report of all CO detectors end of life status.
 5. The CO Detector shall activate upon the following conditions:
 - a. 70 PPM for 60 – 240 minutes
 - b. 150 PPM 10- 50 minutes
 - c. 400 PPM 4 – 15 minutes
 6. The CO activation shall be programmable type as follows: Alarm, Supervisory Latching, Supervisory Non-Latching, Monitor Latching, or Monitor Non-Latching.
 7. Device shall have a sounder base with remote colored alarm light/strobe.
- D. Intelligent 135 Degree Fixed Temperature / Rate of Rise Heat Detector
1. Where called for on the contract drawings, provide intelligent combination fixed temperature/rate-of-rise heat detectors at the locations shown on the drawings. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135 deg F and a rate-of-rise alarm point of 15 deg F per minute. The heat detector shall be rated for ceiling installation at a minimum of 70 ft centers and be suitable for wall mount applications.
- E. Fixed Temperature Heat Detector (135 deg F and 190 deg F)
1. Where called for on the contract drawings, provide addressable intelligent fixed temperature heat detectors at the locations shown on the drawings. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. The heat detector shall have a nominal alarm point rating of 135 deg F and 190 deg F where indicated. The heat detector

- shall be rated for ceiling installation at a minimum of 70 ft centers and be suitable for wall mount applications.
2. Provide:
 - a. 135 deg F fix.
 - b. 190 deg F fix.
- F. Fixed Temperature Heat Detector (200°F) Conventional Device
1. For all Boiler Rooms, Kiln Rooms and other areas of high ambient heat sources (unconditioned spaces), furnish and install a 200 deg F fixed temperature heat detector with base.
 2. Include addressable monitor module for each and mount in adjacent area with standard ambient room conditions.
- G. Detector Base Types
1. Provide standard detector mounting bases suitable for mounting on 1-gang, or 4 inch octagon box and 4 inch square box. The base shall, contain no electronics and support all series detector types.
 2. Provide relay detector mounting bases (where shown) suitable for mounting on 1-gang, or 4" octagon box and 4" square box. The relay base shall support all Signature Series detector types and have the following minimum requirements:
 - a. The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
 - b. The position of the contact shall be supervised.
 - c. The relay shall automatically de-energize when a detector is removed.
 - d. The operation of the relay base shall be controlled by its respective detector processor or under program control as required by the application. Detector relays not capable of operational programming independent of the detector shall not be considered equal. Form "C" Relay contacts shall have a minimum rating of 1 amp @ 30 Vdc and be listed for "pilot duty".
 - e. Removal of the respective detector shall not affect communications with other detectors.
 3. Provide audible detector mounting bases (where shown) suitable for mounting on 4" x 4" octagonal concrete ring (mud box) and 4" square x 2-1/8" deep box.
 - a. The base shall support all Signature Series detector types and be capable of single or group operation. The audible base shall emit a temporal alarm tone and be selectable for low or high output. For carbon monoxide detector bases, program for special T4 temporal code output to alert when carbon monoxide has been detected. Carbon monoxide warning strobe for space and at Main Office shall be activated.
 - b. The operation of the audible base shall be controlled by its respective detector processor or under program control as required by the application. Detector audible base not capable of operational programming independent of the detector shall not be considered equal.
 - c. The audible bases shall be UL268 and UL464 Listed, and provide a reverberant room sound output per UL464 of 81 dBA at 10ft and an average anechoic sound output of 90 dBA at 10 ft.

- H. Intelligent Duct Smoke Detector – Photoelectric
1. Provide intelligent photoelectric duct smoke detector at the locations shown on the drawings.
 - a. One form C auxiliary alarm relay rated at 2amps @ 30Vdc. (Not to be used for local fan shut down; use control module.)
 - b. The operating range shall be 100ft/min to 4,000ft/min air velocity and temperature range of -20 to 158F.
 - c. Sample tube can be installed with or without the cover plate and be rotated in 45- degree increments to ensure proper alignment with duct airflow.
 - d. Provide Siemens units with Head and Tubes.
 2. Provide remote test station with Alarm LED and Key Switch.
 3. Relay Fan Shutdown: Rated to interrupt fan motor control circuit. Furnish and install "separate" device for each motor starter. Connect to motor starter as required for local fan shutdown during alarm condition.
Coordinate with Owner prior to programming.

2.8 INTELLIGENT MODULES

- A. It shall be possible to address each intelligent module using rotary switches. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller.
1. Integral Microprocessor: All decisions are made at the module determining if the device is alarm or trouble condition.
 2. Automatically updates historic information including hours of operation, number of alarms and troubles, time of last alarm.
 3. Automatic Device Mapping: Each detector transmits wiring information regarding its location with respect to other devices on the circuit, creating an As-Built wiring diagram. This will also provide enhanced supervision of the device physical location. The device message shall reside with the location and not the device address. Devices installed in the wrong location will always report the correct message of the physical location.
 4. Twin Status LEDs: The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status.
 5. Input and output circuit wiring shall be supervised for open and ground faults.
 6. Two styles of modules shall be available, those designed for gang box mounting, and where multiple modules are required in a single location, plug in modules shall be provided with a Universal Input/Output motherboard.
- B. Intelligent Input Module. The Input Module shall provide one or two supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2-1/2" deep 1-gang boxes and 1-1/2" deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types:
1. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
 2. Normally-Open Alarm Delayed Latching (Waterflow Switches)

3. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
 4. Normally-Open Active Latching (Supervisory, Tamper Switches)
- C. Intelligent Relay Module. Provide addressable control relay circuit modules shall provide one (1) form C dry relay contacts rated at 24Vdc @ 2 amps (pilot duty) to control external appliances or equipment. The position of the relay contact shall be confirmed by the system firmware. The module shall be suitable for mounting on North American 2-1/2" deep 1-gang boxes and 1-1/2" deep 4" square boxes with 1-gang covers.
- D. NAC Control Module: Provide intelligent NAC control module shall provide one (1) supervised Class A output circuit capable of a minimum of 2 personalities, each with a distinct operation. The gang box -mounted version shall be suitable for mounting in North American 2-1/2" deep 2-gang boxes and 1-1/2" deep 4" square boxes with 2-gang covers. The plug-In version shall plug into a universal multi-module motherboard. The NAC control module shall support the following operations:
1. 24volt NAC circuit
 2. Audio notification circuit 25v.
 3. Telephone Power Selector with Ring Tone (Firefighter's Telephone)
 4. Visual Synchronized Output to Genesis appliances or to NAC Power Supply.
- E. FA Elevator Interface Cabinet (Coordinate with Elevator Contractor)
1. Provide red metal cabinet enclosure with word FIRE in white letters on the cover. Inside will be four intelligent relays (Primary Recall, Alternate Recall, Fire Hat and Shunt Trip), one monitor input (Shunt Trip AC Power Supervision) and 120vac relay (Shunt Trip AC Power Supv).
 2. Label all the relays and input modules for the function.
 3. Provide Siemens Series unit with addressable monitor and control relays as required.

2.9 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 2. The manual pull station will have an intelligent module integral of the unit.
 3. Station Reset: key operated switch shall match the control panel key.
 4. Manual pull stations that initiate an alarm condition by opening the unit are not acceptable.
 5. *For pull stations that are installed behind tamper guards, utilize single action type pull stations.*

- B. Indoor Protective Shield "Stopper Covers": Factory-fabricated clear plastic enclosure. Hinged at the top to permit lifting for access to initiate alarm. Lifting the cover actuates an integral battery powered audible horn intended to discourage false-alarm operation.

2.10 NOTIFICATION APPLIANCES

- A. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions.
- B. Any appliances, which do not meet the above requirements, and are submitted, for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers which clearly states that their equipment (as submitted) are 100% compatible with each other for the purposes intended. All appliances shall be UL 1971, UL 1638 and UL 464 listed for Fire Protective Service. Speakers shall also be UL 1480F listed. Combination Speaker-Visual appliances may be used where shown on the contract drawings and standalone Visual Strobes and Speaker-Only devices may be used where shown on the contract drawings provided they meet the performance requirements specified herein for both audible and visual notification.
- C. Notification Appliances – Visual (Fire – Evacuation)
 - 1. Provide RED wall or ceiling mounted clear lens strobes with red body and "FIRE" markings. Strobes shall provide a smooth light distribution pattern field selectable candela 15 cd, 30 cd, 75 cd, and 110 cd flash output rating, UL1971 listed with in-out screw terminals shall be provided for wiring. The strobe (15, 30, 75, 110) candela rating shall be view from the side window to verify the setting. All strobes shall be synchronization to within 10 milliseconds for an indefinite period shall not require the use of separately installed remote synch modules. The strobes shall mount to one-gang electrical box.
 - 2. The device shall have plastic protective cover for during installation. All ceiling mounted devices shall be provided with junction box and T-grid support bar or other means of adequate support that is U.L. listed.
 - 3. The actual candela setting on the visual shall be marked on the appliance.
- D. Notification Appliances – Visual/Audible (Carbon Monoxide Warning)
 - 1. WHITE wall mounted notification device with AMBER colored lens to indicate presence of carbon monoxide in space. Adjustable visual/audio output settings.
 - 2. With custom warning plaque that reads: "CARBON MONOXIDE HAS BEEN DETECTED. EVACUATE THE SPACE AND CALL FIRE DEPARTMENT." Final verbiage to be coordinate with the Fire Department and Owner. Final plaque size and color scheme as selected by the Architect.
 - 3. Include control module for activating notification device.
 - 4. Device shall have T-4 temporal coding or other as required by the Fire Department.
 - 5. WHITE alarm device with "ALERT" wording with Amber Lens Series Unit.
- E. Notification Appliance – High Fidelity Speaker

1. RED High Fidelity Speakers shall have a 4" Mylar/paper cone. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 25V systems. The actual speaker wattage & strobe candela setting shall be view from the device window to verify the wattage setting, without removing the device. To make any changes to the speaker wattage will only require the removal of the cover plate.
 2. High Fidelity Speaker listed frequency response of 400 to 4,000 Hz and listed sound output of 90.5 dBA at 10 feet, as measured in reverberation room per UL-1480.
 3. Furnish devices with the following selectable minimum sound level output:
 - a. 1/4 watt – 81.5 dBA
 - b. 1/2 watt – 84.1 dBA
 - c. 1 watt – 87.3 dBA
 - d. 2 watt – 90.5 dBA
 - e. All ceiling mounted devices shall be provided with speaker back box and speaker truss support for T-grid ceilings or utilize other U.L. listed support means for other types of ceiling materials.
- F. Notification Appliance - Re-entrant Speakers (Mechanical, Storage, Unfinished Ceiling Locations and Exterior Use)
1. Provide 4 inch diameter red re-entrant speakers at loud ambient locations or for outdoor weatherproof installation. Weatherproof boxes shall be provided for outdoor mounting. Speakers shall provide 2w, 4w, 8w, and 15w power taps. The re-entrant speakers shall utilize a high-efficiency compression driver. Cone type drivers are not acceptable. At the 15 watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480.
 2. Combination speaker strobes shall meet both sections of above.
- G. Trumpet Type Loudspeaker (High-Ceiling Locations)
1. Provide a trumpet speaker at the locations shown on the drawings. The trumpet speaker shall be able to operate within any ambient temperature environment ranging from 150°F to -30°F, with weather-resistant unit shall be constructed of heavy-gauge treat aluminum. Model shall be a double re-entrant type with 15 watts RMS audio power rating compression driver producing a UL-rated sound pressure level of 102dB measured at 15 watts, 10 ft. (3dB increment rating) within a frequency range of 400 Hz to 4 kHz. Impedance shall be 8 ohms and sound dispersion 70°. Unit shall have impedance selection via 7-position switch of 5000, 2500, 1300, 666, 333, 89 and 45 ohms. Power taps shall be available at 1, 2, 3.8, 7.5, 15watts for 70V line. Trumpet loudspeaker assembly shall be furnished with mounting bracket allowing adjustment on either a vertical or horizontal plane with a single locking pin and including provisions for mounting, banding, or strapping. Wiring terminals for amplifier output shall be fully enclosed and a vandal-resistant adapter cover shall provide connection facilities for cable or conduit. Dimensions: 77/8" W x 83/4" H x 95/16" D. Unit shall be finished in either gray baked epoxy or red baked epoxy. Color shall be

verified with Owner prior to ordering and installation. Include wire guards for protection in Gymnasiums.

2. Cooper Wheelock STH-15S-R or equivalent

2.11 SURGE PROTECTION

- A. Install U.L. listed surge protection on normal ac power for the FACP and its accessories.
- B. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.
- C. Install surge protection on all lines entering the building and other out-buildings.
- D. Ground to building ground/water piping system as required.
- E. Manufacturer: Ditek.

2.12 SPRINKLER SYSTEM (*EXISTING*)

- A. Sprinkler Waterflow Switch: Switch shall have two (2) sets of N.O. contacts and adjustable retard chamber to compensate for water surge. Verify quantity in field.
- B. Sprinkler System Gate Valve Supervisory Switch: Verify quantity in field.
- C. Sprinkler System Dry System Pressure Switch and Alarm Switch: Existing.
- D. Provide addressable monitor module for each device listed above.

2.13 BELLS (Existing to remain)

- A. Electric-vibrating, 24-V dc, under-dome type; with provision for housing the operating mechanism behind the bell. Bells shall produce a sound-pressure level of 94 dBA, measured 10 feet from the bell. Size 6 inch inside, 10 inch outside, unless otherwise indicated. Bells are weatherproof where indicated.

2.14 VISIBLE C.O. WARNING STROBE

- A. AMBER colored strobe with WHITE base with "ALERT" or "CO DETECTED" warning verbiage to be activated when any C.O. device goes into alarm. Provide warning plaque next to strobe with instructions. See drawings for additional information.

2.15 VISIBLE WEATHERPROOF FIRE ALARM INDICATOR (Existing to remain)

- A. Strobe (color selected by Fire Department) mounted above each sprinkler bell outside or as directed by Fire Department. Coordinate final location in field.

2.16 GUARDS FOR PHYSICAL PROTECTION

- A. Provide welded mesh of size and shape for the manual pull stations, smoke detectors, notification appliances at location noted on the drawings.

2.17 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall mounting as indicated and are complete with matching doorplate.
1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
 2. Wall-Mounted Units: Flush or surface mounted as required. **Owner does not want to use floor mounted units.**
 3. Rating: 24-V dc.
 4. Contractor will field verify exact type to be used prior to bidding. Installation of devices must allow for at least 90 degree door swing if adjacent to wall.
 5. Include structural framework and mounting plates as required to accommodate wall mounted type magnetic holders. Include extension rods and extended catch plates as required. Paint structural systems out to match surrounding areas.
 6. If location does not have an adjacent wall to use wall mount magnetic holder, utilize LCN/Sentronic type magnetic door holder/closer.
 7. Where existing door closers have a locking feature to hold door open, remove locking feature from closer. Coordinate work with Owner.

2.18 FIRE ALARM DOCUMENT BOX (existing to remain)

- A. The Fire Alarm Document/System Record Document box shall comply with NFPA 72 document storage requirements. Standard features include 16 ga steel construction with red powder coat, piano hinge, and key lock. A removable document holder and space for a can of detector test gas are standard as are key ring hooks, a business card holder, and an important notes sticker for the door. Also include a minimum 4GB flash drive for digitally storing fire alarm system software, programming, etc. Minimum dimensions shall be 13"H X 12"W x 2-1/4"D.

2.19 INSPECTION BAR CODES (Match existing system and labeling scheme in use)

- A. Company shall provide a web-based reporting system for creating, updating and maintaining all service work, inspections, and maintenance performed as part of this specification to Inspection bar codes shall be installed on all initiating devices, annunciators, control panels and power supplies.
- B. Inspection bar codes used by the system must utilize Code 3 of 9 or other approved format, and contain a minimum of eight (8) digits that comprise a unique serial identifier within the Web-based Reporting System. There shall be no duplication of serial numbers. Serial number shall be printed below the bar code for identification purposes.
- C. Inspection bar codes shall be limited in size to no more than 2 inches in width, and 3/8 inches in height and shall include a Mylar or other protective coating to protect the bar code from fading due to sunlight or exposure.
- D. Inspection bar codes shall be installed on each device in such a manner as to require that scanning of the bar code take place no further than 12 inches from the device during inspection.

- E. Include software to Owner including all associated licenses and Excel Spreadsheet form with this information on all fire alarm devices, their device type, location, address, bar code, date of inspection, pass/fail status, etc. Include electronic file of this including hard copy to owner as part of close out documents. Continue numbering sequence in order of last device listed.

2.20 WIRE AND CABLE (*PLENUM RATED*)

- A. Signaling Line Circuits – Network Data: Plenum rated cable (FPLP), twisted pair, not less than No. 16 AWG or as recommended by the manufacturer. Systems which use Shielded Wire requiring continuous foil shields and continuous drain wires are not acceptable, as they may lead to multiple ground faults and communication integrity faults.
- B. Signaling Line Circuits – Intelligent Loop: Plenum rated cable (FPLP), non-Twisted pair, not less than No. 16 AWG or as recommended by the manufacturer. Systems which use Shielded Wire requiring continuous foil shields and continuous drain wires are not acceptable, as they may lead to multiple ground faults and communication integrity faults.
- C. Notification Appliance Circuits
 1. Audio: Plenum rated (FPLP), shielded, twisted pair, not less than No. 16 AWG or as recommended by the manufacturer.
 2. Visual. Plenum rated (FPLP), non-Twisted pair, not less than No. 14 AWG or as recommended by the manufacturer and required by the voltage drop calculations (it may be No. 12 AWG in some cases).
- D. Cable/Wire Color Coding:
 1. Signal Line Circuit- SLC: Overall red jacket with black and red conductors.
 2. DC power supply circuit: Overall red jacket with violet and brown conductors.
 3. Notification Appliance Circuit- NAC: Overall red jacket with blue and white conductors.
 4. Door release circuit: Gray conductors.
 5. Central station trip circuit: Orange conductors.
 6. Central station fire alarm loop: black and white conductors.
- E. Manufacturers:
 1. Rockbestos-Suprenant Cable Corp.
 2. Radix
 3. Comtran Corp.
 4. Helix
 5. West Penn/CDT.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. The Contractor shall schedule work so as not to interrupt areas of the building being used by the Owner. Work shall be performed in those areas once activities have ended or shall not be scheduled in those areas for that day.

Contractor to work with the Owner in order to prioritize areas of the building to be completed first.

1. Contractor shall protect all rooms while working within them. Cover all furniture and equipment. Move desks and furniture as needed. Return room as originally found and clean up all debris on a daily basis.
 2. Contractor to provide their own lifts and ladders.
 3. Contractor to inspect all ceiling tiles for damage prior to starting their work. If any damage is found they shall bring it to the attention of the Owner in writing prior to performing any work. If this document is not provided the contractor is assuming the liability for replacing all damage tiles discovered after the completion of the project. All damaged tiles found will be replaced at the contractor's expense.
- B. Comply with NFPA 72 and Article 760 for installation of fire-alarm equipment.
- C. All new system devices (initiating and notification) shall be inspected and tested for operation including the operation of air handlers and roof top units under shut down sequence. All NAC panels shall be checked for supervision. See drawings for sequence of operation matrix to understand current operation of system. All devices not labeled shall be labeled per the specifications.
- D. The contractor shall download the system software with all associated programmed devices onto an electronic disk for the Owner's safekeeping. Include a printout of all system devices, locations, nomenclature and their address. Have the Owner sign for the disk and print out prior to performing any work on the system.
- E. Coordinate the pretest date and time with the Owner a minimum of one week in advance. The Owner will be required to be present with the technician during the pretest. All tests done without the Owner's presence will be redone at the contractor's expense.
- F. Equipment Mounting: Install fire-alarm control unit on wall with tops of cabinets not more than 72 inches above the finished floor.
- G. Smoke- or Heat-Detector Spacing:
1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 3. Smooth ceiling spacing shall not exceed 30 feet.
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix in NFPA 72.
 5. HVAC: Locate detectors not closer than 5 feet from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
 7. DO NOT INSTALL HEAT DETECTORS ABOVE MECHANICAL HEATING PIPES, ADJUST LOCATION ACCORDINGLY TO PREVENT FALSE ALARMS.
- H. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

- I. Heat Detectors in Elevator Shafts and Elevator Machine Room: Coordinate temperature rating and location with sprinkler rating and location. Mount within 24 inches of sprinkler heads. Devices when activated shall operate elevator main circuit breaker via shunt trip mechanism. Furnish and install control module for operating shunt trip mechanism and monitor module for supervising control circuit. Provide monitor modules for elevator shaft and machine room sprinkler tamper switches.
- J. Smoke Detectors in Machine Rooms and Lobbies: Install smoke detectors and connect to fire alarm system. Install control modules for operation of primary and secondary elevator recall positions.
- K. Elevator Fire-Fighters Hat Indicator Light: Connect to fire alarm control panel through control module. Hat light to be activated when fire alarm system encounters an alarm condition.
- L. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- M. Audible Alarm-Indicating Devices (When Wall Mounting): Install at 80 inches above finished floor to bottom or 6 inches below the ceiling, whichever is less. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install ceiling mounted devices when shown.
- N. Visible Alarm-Indicating Devices (When Wall Mounting): Install adjacent to each alarm bell or alarm horn and at least 80 inches above finished floor to bottom or 6 inches below the ceiling, whichever is less. Install ceiling mounted devices when shown.
- O. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- P. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- Q. Annunciator: Install with top of panel not more than 56 inches above the finished floor to top of unit, unless unit is large in size. Coordinate with Engineer.
- R. Pull Stations: Mount top of unit at 48 inches above finished floor.
- S. Furnish and install additional power sub-panels as required to obtain power to new "NAC" panels. Two breakers from one existing 120/208 volt emergency power panel shall be removed to accommodate the installation of a two pole, 50 amp breaker. The sub-panel and feeder shall be rated for 50 amp single phase, three wire with ground. Conduit shall be type EMT. Install two breakers sized to match existing removed and reconnect to existing branch circuit. Extend wiring as required. Install additional single pole breakers to power new "NAC" panels. Install lock-out device on breakers serving "NAC" panels. Install card directory. Panel shall be U.L. listed, equivalent to Square-D NQOD System. All bussing shall be copper. All breakers shall be "QOB" style.

- T. All "NAC" panels being remotely located shall be protected with a smoke detector. Mount detector above all panel locations and connect to system.
- U. If the contractor is unable to maintain an active fire alarm system during times of construction, a certified Fire Watchman (approved by the Fire Department) shall be hired to guard the building. All costs shall be part of this contract. No additional costs will be incurred by the Owner. At no time shall the building be left unprotected/unsupervised, including on days when Staff are within the building. String up temporary detectors throughout the building for protection as required. Remove once new system is operational.
- V. Furnish and install spare fire alarm key and security alarm code in Knox box. Coordinate with Fire Department for access. Tie in to FACP for monitoring.
- W. Contractor shall coordinate with Owner in programming three (3) emergency messages for their use.
- X. Contractor shall coordinate with Owner and Fire Department on which message or system warning tones shall be used for all alarm or initiated conditions.

3.2 WIRING INSTALLATION

- A. ALL WIRING TO BE PLENUM RATED, FIRE PROTECTION LISTED AND INSTALLED IN RACEWAY.
- B. Install wiring according to the following:
 - 1. NECA 1.
 - 2. TIA/EIA 568-C.
- C. All wiring shall be color coded as follows: all junction boxes and conduit (Allied Red Raceway) above ceilings to be painted red and labeled "FIRE ALARM" in black lettering. Identify circuiting information for both initiating and notification circuits. All exposed raceways to be red in color unless otherwise directed by Architect/Owner.
- D. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems."
 - 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
 - 2. All fire alarm junction boxes and conduits being installed above ceilings shall be "RED" in color. All exposed conduit approved by architect shall be painted out to match surrounding area. Coordinate with Owner prior to ordering.
 - 3. All raceways shall be supported from bar joists. Do not fasten to other electrical conduits, other system piping or raceway, ceiling system supports, etc.
 - 4. Do not install conduit above top chord of bar joists or within 6 inches of roof deck so as to prevent damage from roofing nails.
 - 5. All surface mounted back boxes shall match device color with same shape and size with no visible knockouts. Back boxes shall be manufactured by the fire alarm device manufacturer so as to properly fit the device and match the devices required depth.

- E. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- F. Cable Taps: DO NOT INSTALL TAPS OUTSIDE OF FIRE ALARM DEVICES. Wire from device to device.
- G. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- H. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- I. All fire alarm terminal and junction locations shall be identified in accordance with NFPA 70, Section 760-3 and the latest edition of the National Electrical Code. All junction and terminal boxes shall be painted red and stenciled "Fire Alarm." This requirement is to prevent unintentional interference with the signaling circuits during testing, servicing and additional modifications to the system.
- J. Connect fire protection sprinkler bell to 24VDC power circuit from fire alarm system.
- K. Install new fire alarm zone maps (in plexi-glass frame with metallic frame boarder) showing existing and new devices and "NAC" panels at both control and annunciator panel locations. Refer to drawings for additional information. Provide copy, including electronic copy, to Fire Department.
- L. Remove and replace ceiling systems as required for installation of work. Replace all damaged ceiling materials with type to match existing ceiling without any additional cost to the Owner.
- M. Where ceiling devices are removed and openings are abandoned, install blank coverplate and replace ceiling tile to match surrounding area.
- N. Where wall devices are removed and openings are abandoned, install blank finished coverplate. Furnish and install oversized coverplates as required to obtain a finished look. Paint out to match surrounding area.
- O. When raceway and devices are removed and leave existing walls and ceilings marked by absence of materials, existing walls and ceilings shall be patched and painted to match surrounding areas.

3.3 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements. Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are UL/FM listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to elevator recall system and components.
 - 3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 4. Supervisory connections at valve supervisory switches.
 - 5. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 6. Supervisory connections at elevator shunt trip breaker.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems." Provide identification labels on all cabling entering all panels and junction boxes.
- B. Install framed instructions in a location visible from fire-alarm control unit.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM."
- D. Program all addressable initiating devices with their true building location. Utilize Owner's final building room name and number plan. Do not use electrical drawing room labeling unless authorized by the Owner and verified by the Architect. Contractor shall bear all costs associated with walking each room/area for verification of actual room numbers prior to programming, no exceptions. Label all devices with their addressable identification and circuit numbering scheme. Use P-Touch label maker. Do not use markers.
- E. Inspection Bar Codes:
 - 1. Inspection bar codes shall be installed on all initiating devices, annunciators, control panels and power supplies. These bar codes shall support future testing and archiving of the test via building reports.com protocol.
 - 2. Inspection bar codes used by the system must utilize Code 3 of 9 or other approved format, and contain a minimum of eight (8) digits that comprise a unique serial identifier within the Web-based Reporting System. There shall be no duplication of serial numbers. Serial number shall be printed below the bar code for identification purposes.
 - 3. Inspection bar codes shall be limited in size to no more than 2" in width, and 3/8", in height and shall include a Mylar® or other protective coating to protect the bar code from fading due to sunlight or exposure.

4. Inspection bar codes shall be installed on each device in such a manner as to require that scanning of the bar code take place no further than 12" from the device during inspection.

3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6 FIELD QUALITY CONTROL (*GENERAL*)

- A. Field tests shall be conducted by manufacturer's service representative and witnessed by the Owner, Engineer and authorities having jurisdiction (Fire Department). Notify local authorities having jurisdiction (AHJ), Owner and Engineer one (1) week in advance of inspection and testing, in writing with copies to Architect's/Engineer's office. Coordinate with owner in advance of scheduling with AHJ.
- B. Two (2) tests shall be required to be performed by the fire alarm manufacturer's representative/technician:
 1. First Test to be performed by contractor to ensure system is operating correctly.
 2. Second test to be performed with Owner, Engineer and Fire Department/County Inspector.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. Tests and Inspections:
 1. Intelligibility testing (refer to Paragraph 3.08 for scope of this work).
 2. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
 - a. Devices that are outside their marked sensitivity range shall be replaced.
 3. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
 - b. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - c. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 4. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 5. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable

- sound-level meter complying with Type 2 requirements in ANSI S1.4. Modify and adjust audible taps to meet room needs.
6. Test audible appliances for the private operating mode according to manufacturer's written instructions. Modify and adjust audible taps to meet room needs.
 7. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 8. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Testing General:
1. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
 2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
 3. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
 4. Test reports shall be delivered to the acceptance inspector as completed.
 5. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:
 - a. Ladders and scaffolds as required to access all installed equipment.
 - b. Multi-meter for reading voltage, current and resistance.
 - c. Two-way radios and flashlights.
 - d. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.
 - e. Decibel meter, complying with Type 2 Requirements in ANSI S1.4.
 - f. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.
- F. After tests have been completed, obtain written certification from Fire Department and include in As-Built/O&M Documentation.
- G. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- H. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- I. Prepare test and inspection reports.
1. Upon completion of installation of fire alarm equipment, electrical contractor and fire alarm contractor shall provide to the engineer a signed, written statement substantially in the form as follows:

"The undersigned having been engaged as the electrical contractor and fire alarm contractor on the **Oakton Community College** building confirms that the fire alarm equipment was installed in accordance with wiring diagrams, instruction and directions provided to us by the manufacturer and authorities having jurisdiction, and system as installed complies with local codes and NFPA codes."

2. Turn over Inspection Report to Owner showing all devices on the system, both initiating and notification devices, and all other active devices, with PASS / FAIL report for each. Each device shall be listed with their address, device location, and their panel display label. All devices that fail shall be fixed and re-tested until they pass.
- J. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- 3.7 ACCEPTANCE TESTING (ADDITIONAL INFORMATION/PROCEDURES)
- A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the engineer in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.
 - B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.
 - C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
 - D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the owner and test results recorded for use at the final acceptance test.
 - E. Preliminary Testing: Conduct preliminary tests and intelligibility tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
 - F. Final Acceptance Test: Notify the owner in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test will not be scheduled until meggar test results, the loop resistance test results, and the submittals required in Part 1 are provided to the owner. Test the system in accordance with the procedures outlined in NFPA 72.
 1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.

2. Test each initiating and indicating device (public operating mode) and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
 3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
 4. Visually inspect all wiring.
 5. Verify that all software control and data files have been entered or programmed into the FACP.
 6. Verify that Shop Drawings reflecting as-built conditions are accurate.
 7. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.
 8. Measure voltage readings for circuits to assure that voltage drop is not excessive.
 9. Measure the voltage drop at the most remote appliance on each notification appliance circuit.
- G. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:
1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - a. Open, shorted and grounded signal line circuits.
 - b. Open, shorted and grounded notification, releasing circuits.
 - c. Primary power or battery disconnected.
 2. System notification appliances shall be demonstrated as follows:
 - a. All alarm notification appliances actuate as programmed.
 - b. Audibility and visibility at required levels.
 3. System indications shall be demonstrated as follows:
 - a. Correct message display for each alarm input at the control display.
 - b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
 - c. Correct history logging for all system activity.
 4. System off-site reporting functions shall be demonstrated as follows:
 - a. Correct zone transmitted for each alarm input.
 - b. Trouble signals received for disconnect.
 5. Secondary power capabilities shall be demonstrated as follows:
 - a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
 - b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
 - c. System battery voltages and charging currents shall be checked at the fire alarm control panel.

3.8 INTELLIGIBILITY TESTING AND ACOUSTIC ADJUSTMENT

- A. Installing Contractor and Fire Alarm Distributor Shall include in their bid all costs to provide two (2) full Intelligibility Tests of all Acoustically Distinguishable Spaces (ADS). Such tests shall be made and witnessed in the presence of the Owner and/or their designated representative.
- B. Intelligibility testing of the System shall be accomplished in accordance with NFPA 72 for Voice Evacuation Systems, IEC 60268-16, and ASA S3.2.
 1. Following are the specific requirements for intelligibility tests:
 - a. Intelligibility Requirements: Verify intelligibility by measurement after installation.
 - b. Ensure that a CIS value greater than the required minimum value is provided in each area where building occupants typically could be found. The minimum required value for CIS is 0.65.
 - c. Areas of the building provided with hard wall and ceiling surfaces (such as metal or concrete) that are found to cause excessive sound reflections may be permitted to have a CIS score less than the minimum required value if approved by the AHJ installation, and if building occupants in these areas can determine that a voice signal is being broadcast and they must walk no more than 33 feet to find a location with at least the minimum required CIS value within the same area.
 - d. Areas of the building where occupants are not expected to be normally present are permitted to have a CIS score less than the minimum required value if personnel can determine that a voice signal is being broadcast and they must walk no more than 50 feet to a location with at least the minimum required CIS value within the same area.
 - e. Take measurements near the head level applicable for most personnel in the space under normal conditions (e.g., standing, sitting, sleeping, as appropriate).
 - f. The distance the occupant must walk to the location meeting the minimum required CIS value shall be measured on the floor or other walking surface as follows:
 - 1) Along the centerline of the natural path of travel, starting from any point subject to occupancy with less than the minimum required CIS value.
 - 2) Curving around any corners or obstructions, with a 12 inches clearance there from.
 - 3) Terminating directly below the location where the minimum required CIS value has been obtained.
 2. Use commercially available test instrumentation to measure intelligibility as specified by ISO 7240-19 and ISO 7240-16 as applicable. Use the mean value of at least three readings to compute the intelligibility score at each test location.
 3. Record all intelligibility readings for the ADS in the web-based bar code inspection and testing software and affix barcode to the nearest audible notification appliance closest to the entrance or exit from the ADS.

- C. Upon completion of fire alarm system installation, the contractor shall perform an audibility level check in all occupied spaces. Adjust all speakers to assure sound levels meet code:
 - 1. 15 dB above average ambient sound levels or 5 dB above maximum ambient sound level (whichever is greater).
 - a. Classrooms Average Ambient Sound Level: 50 dB
 - b. Offices Average Ambient Sound Level: 45 dB
 - c. Corridors Average Ambient Sound Level: 60 dB
 - d. Gymnasiums and Warehouses Average Ambient Sound Level: 80 dB
 - e. Cafeteria Average Ambient Sound Level: 75 dB
 - f. Toilet Rooms Average Ambient Sound Level: 35 dB
 - g. Exterior Locations at Property Line Not to Exceed 50 dB in alarm mode.
 - 2. Contractor to verify average ambient sound levels for each space prior to adjusting speaker tap settings.
- D. Provide a preliminary report to the Owner and Owner's Representative for review. Include time for a review meeting to discuss the results and any areas for adjustments.
- E. Provide one (1) full speaker tap setting adjustment to each notification appliance within the entire audible notification appliance network. Adjust speaker wattage tap settings up or down based upon the direction provided by the Owner's Representative. Do not adjust speaker tap settings for speakers or areas which are not determined to need adjustment.
- F. Provide a second full Intelligibility Test and Final Intelligibility Report to the Owner and Owner's Representative for approval.

3.9 DOCUMENTATION (3 SETS REQUIRED)

- A. System documentation shall be furnished to the owner and shall include but not be limited to the following:
 - 1. System record drawings and wiring details including THREE (3) sets of drawings, and a Memory Stick with copies of the record drawings in DXF format for use in a CAD drafting program, and in "PDF" format.
 - 2. System operation, installation and maintenance manuals.
 - 3. System matrix showing interaction of all input signals with output commands.
 - 4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.
 - 5. System program showing system functions, controls and labeling of equipment and devices.
 - 6. System print out showing all active devices, their address, and room location.

3.10 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit

actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

- B. Annual Test and Inspection: Eleven months after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections. Repair/replace all defective parts at no additional cost to the Owner. Contractor shall schedule this with Owner at the ten month point after substantial completion. If this procedure is not done and the warranty has expired, the contractor/manufacturer will be liable for all defective parts after the warranty expiration period for an indefinite period of time.

3.11 DEMONSTRATION (At the Owner's discretion)

- A. Coordinate exact Date and Time with Owner.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 01 Sections.

3.12 PASSCODES

- A. At the end of the project, the contractor shall turn over all fire alarm control panel passcodes to the Owner. Include all necessary documentation as needed for the safeguarding and transferring of this information to the Owner. Obtain signature from the Owner for the receipt of this information and include in the close out documents.

END OF SECTION