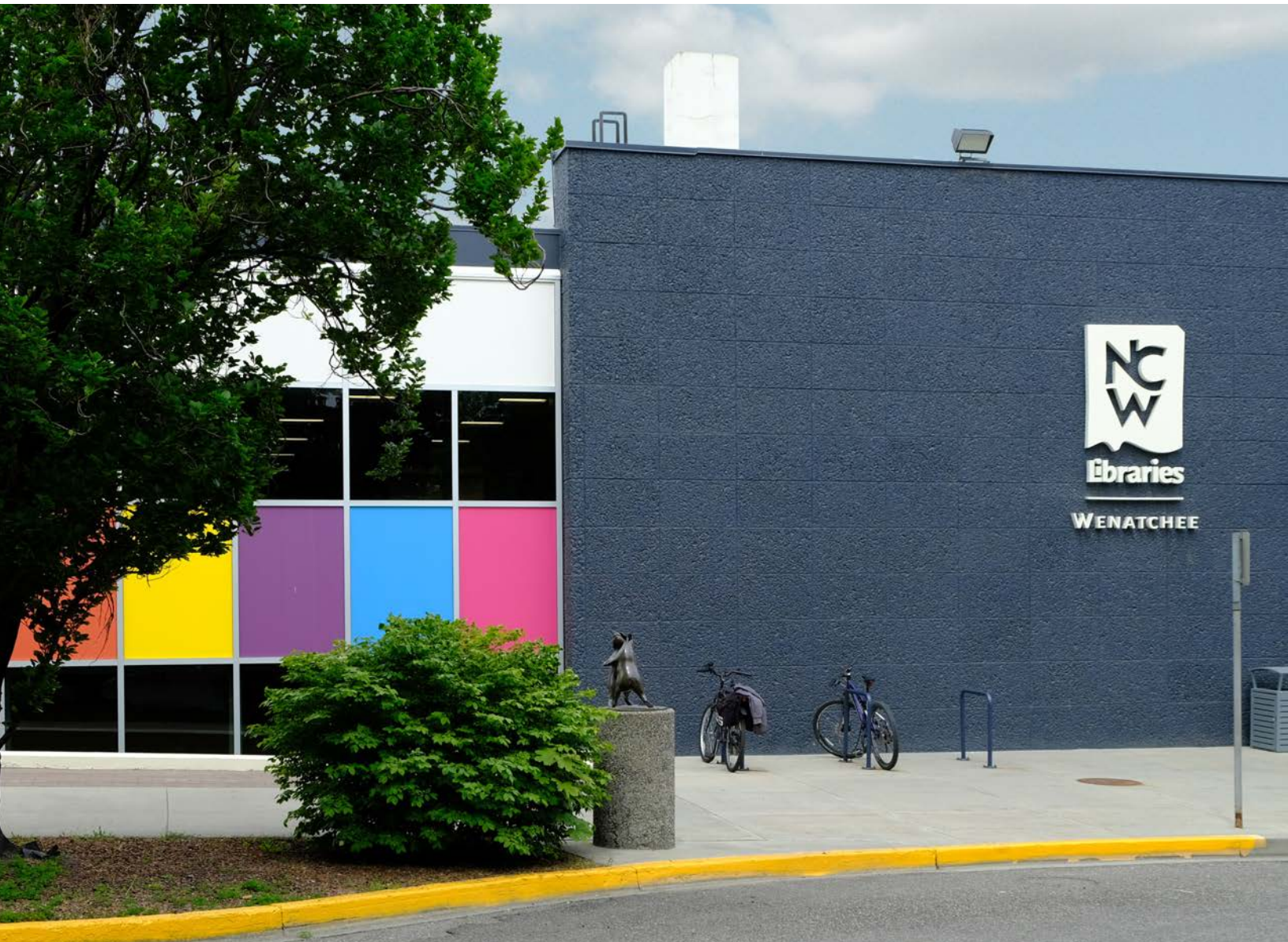




Wenatchee Public Library Phase II Renovation Bid Set Project Manual

August 28, 2023



BUILDINGWORK

architecture design preservation

Wenatchee Library Phase 2 Modernization

310 Douglas Street
Wenatchee, WA 98801



Bid Set Dated August 28, 2023

ARCHITECT:

BuildingWork
Attn: Kate Weiland, AIA
159 Western Avenue West, Suite 486
Seattle, WA 98119
206-775-8672
kate@buildingwork.design

ELECTRICAL ENGINEER:

KWR Electrical Consulting and Design
Attn: Aaron Whiting
5915 S Regal Street Suite 201
Spokane, WA 99233
509-473-9218
aaron@KWRLLC.com

MECHANICAL ENGINEER:

Kartchner Engineering
Attn: Sydney Harmon
101 S Stevens Street Suite 201
Spokane, WA 99201
509-922-0380
sydneyh@kartchnerengineering.com

VOLUME ONE

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NOTICE TO CONTRACTORS

Sealed bids and other items required in accordance with the following Instructions to Bidders as contained in the Contract Documents, dated August 28, 2023, prepared by BuildingWork, 159 Western Avenue West, Suite 486, Seattle, WA 98119, will be received by NCW Libraries for construction of the Wenatchee Public Library Phase 2 Modernization, in Wenatchee, WA. Bids are due on or before 2:00 pm on Wednesday, October 18, 2023. Bids received after this time will not be considered. Bids shall be delivered to:

NCW Libraries
Attention: Amanda Lawson
16 North Columbia Street
Wenatchee, WA 98801

A mandatory pre-bid meeting will be conducted on Tuesday, September 12, 2023 at 8:00 AM PDT, at the library.

Sealed bids may be delivered by certified US mail or courier. Electronic bids will not be accepted or opened. Bids will be opened and read publicly by NCW Libraries immediately following the hour as set above. General Contractors are welcomed to attend the bid opening, which will be held at 16 North Columbia Street, Wenatchee, WA 98801.

Each bid shall be submitted in accordance with Project Bidding and Construction Document requirements and shall be accompanied by a Bid Bond or Cashier's Check made payable to NCW Libraries, in the amount of not less than 5% of the total amount of the Base Bid and all Alternates. Performance and Payment Bod for 100% of the Contract will be required as a condition of Contract.

Bid Work is in accordance with that described under Division 1, Section 01 10 00 – SUMMARY.

NCW Libraries reserves the right to reject any or all proposals and the right to waive any irregularities or information in any proposal, subject to the Public Works Laws of the State of Washington, as may be deemed in the best interest of the Library. NCW Libraries reserves the right to reject a proposal which is not accompanied by the required bid security, and incomplete or irregular proposals which may exclude or modify any item(s) required by the Bid Documents. No proposals will be accepted after the hour set for receipt of proposals, as indicated above.

Wages on this project are subject to Washington State Prevailing Wage rates.

Bidding Documents as prepared by BuildingWork, including Instructions to Bidders, For of Agreement, General Requirements, Drawings and Specifications entitled, **Wenatchee Public Library Phase 2 Modernization**, dated August 28, 2023 are available at www.ncwlibraries.org/bidopportunities, and the online plan center of Builder's Exchange of Washington at www.bxwa.com. Bidders may download digital files free of charge from the NCW Libraries website. It is the Bidders responsibility to download and print documents if they so choose.

Notification of Bidding Opportunity will be published in the Wenatchee World and the Seattle Daily Journal of Commerce.

INSTRUCTIONS TO BIDDERS

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Article 1 – Definitions

- 1.1 Bidding Documents include the Bidding Requirements and the Proposed Contract Documents.
- 1.2 Definitions set forth in the Contract for Construction apply to the Bidding Documents.
- 1.3 Addenda are written or graphic instruments issued by the Architect, which, by additions, deletions, clarifications, or corrections, modify or interpret the Bidding Documents.
- 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents, to which Work may be added or deleted by sums stated in the Alternate Bids.
- 1.6 An Alternate Bid is an amount stated in the Bid to be added or deducted from, of that does not change, the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.
- 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment, or services or a portion of the Work, as described in the Bidding Documents.
- 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

Article 2 – Bidder's Representations

- 2.1 By submitting a Bid, the Bidder represents that:
 - 1.the Bidder understand the Bidding Documents;
 - 2. the Bid complies with Bidding Documents;
 - 3. The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed, and has correlated the Bidder's observations with the requirements of the Proposed Contract Documents;
 - 4. the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception; and
 - 5. the Bidder has read and understand the provisions for liquidated damages, if any, set forth in the form of Agreement between NCW Libraries and Contractor.

Article 3 – Bidding Documents

- 3.1 Bidders shall use complete sets of Bidding Documents in preparing Bids; neither NCW Libraries nor Architect assumes responsibility for errors or misinterpretations resulting from use of incomplete sets of Bidding Documents.

- 3.2 The Bidding Documents are for the sole purpose of obtaining Bids on the Work. No license or grant of use is conferred by distribution of the Bidding Documents.
- 3.3 Requests for clarification of the Bidding Documents shall be submitted by the Bidder to the Architect within seven days prior to the date for receipt of bids. Questions are to be emailed to Kate Weiland: kate@buildingwork.design Modifications and interpretations of the Bidding Documents shall be made by Addendum.
- 3.4 Written requests for substitutions shall be received by the Architect at least ten days prior to the bid due date. A substitution request shall include 1) name of equipment or material specified in the Bidding Documents; 2) the reason for requested substitution; 3) a complete description of proposed substitution including the name of the material or equipment proposed as the substitute; and 4) any other information necessary for an evaluation including a point by point comparison to the specified product. If the Architect approves a proposed substitution prior to receipt of Bids, such approval shall be set forth in an Addendum.
- 3.5 Addenda will be posted to the online plan access points listed above to known Bidders. Addenda will be available where Bidding Documents are on file. Addenda will be issued no later than four days prior to the Bid due date.

Article 4 – Bidding Procedures

- 4.1 Bids shall be submitted on the forms included in the Bidding Documents, legibly executed. Paper bid forms shall be executed in a non-erasable medium. Sums shall be in both words and numbers. In case of discrepancy, words shall govern. Edits to entries, prior to Bid due date, shall be initialed by the signer of the Bid.
- 4.2 All requested alternates shall be bid. If no change in the Base Bid is required, enter “no change.”
- 4.3 Each copy of the Bid shall state the legal name and legal status of the Bidder. As part of the documentation submitted with the Bid, the Bidder shall provide evidence of its legal authority to perform the Work in the jurisdiction where the property is located. Each copy of the bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract.
- 4.4 A Bidder shall incur all costs associated with the preparation of its Bid.
- 4.5 Each Bid shall be accompanied by a bid security in the form and amount required by the Invitation to Bid. The Bidder agrees to enter into a Contract with NCW Libraries on the terms stated in the Bid and will furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds, the amount of the bid security shall be forfeited to NCW Libraries as liquidated damages. The amount of the bid security shall not be forfeited to NCW Libraries in the event NCW Libraries fails to comply with Section 6.2. Bid security received from low and second low bidder will be retained until contract is executed.
- 4.6 If a surety bond is furnished with Bid, it shall be written on AIA Document A310-2010 Bid Bond. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of an acceptable power of attorney. The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.
- 4.7 NCW Libraries has the right to retain the bid security until 1) the Contract has been executed and all bonds have been furnished; 2) the specified time has elapsed so the Bids may be withdrawn; or 3) all Bids have been rejected.
- 4.8 Bidders shall submit their Bids as indicated in the Instructions to Bidders. Paper copies of the Bid, the bid security, any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be identified with the Project name and the Bidder's

name and address. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope notated "SEALED BID ENCLOSED" on the face thereof.

- 4.9 Prior to the date and time designated for receipt of Bids, a Bidder may submit a new Bid to replace a previously submitted Bid, or withdraw a Bid entirely, by notice to the party designated to receive the Bids. Such notice shall be received and recorded.

Article 5 – Consideration of Bids

- 5.1 Unless otherwise prohibited by law, NCW Libraries shall have the right to reject any or all Bids.
- 5.2 It is the intent of NCW Libraries to award a Contract to the lowest responsive and responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. NCW Libraries shall have the right to waive informalities and irregularities in a Bid received if it is determined to be in the best interest of NCW Libraries.
- 5.3 NCW Libraries shall have the right to accept Alternates in any order of combination and to determine the lowest responsive and responsible Bidder on the basis of the sum of the Base Bid and Alternates accepted.

Article 6 – Post Bid Information

- 6.1 Bidders to whom award of a Contract is under consideration shall submit to NCW Libraries, within 5 days after the public bid opening, a Contractor's Qualification Statement, Section 00 30 10 of this specification.
- 6.2 A Bidder to whom award of a Contract is under consideration may request in writing, seven days prior to the expiration of the time for withdrawal of Bids, that the NCW Libraries furnish to Bidder reasonable evidence that NCW Libraries can fulfill financial obligations of the Contract.

Article 7 – Performance and Payment Bonds

- 7.1 The Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder.
- 7.2 The cost of Performance and Payment bonds shall be added to the Bid in determining the Contract Sum.
- 7.3 The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.
- 7.4 The Penal Sum of the Performance and Payment Bonds shall be in the amount of the Contract Sum.
- 7.5 The Bidder shall deliver the required bonds to the Owner no later than three days following the date of Contract execution.
- 7.6 The bonds shall be written on AIA Document A312-2010 Payment Bond and dated on the date of the Contract.
- 7.7 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix to the bond a certified and current copy of the power of attorney.

Article 8- Enumeration of the Proposed Contract Documents

- 8.1 Copied of the proposed Contract Documents have been made available to the Bidder and consist of the following documents:
1. Bid Set Drawings date August 28, 2023
 2. Bid Set Project Manual dated August 28. 2023
 3. Invitation to Bid

End of Section

TO: NCW Libraries

Having carefully examined the Bidding Requirements and Contract Documents entitled Wenatchee Public Library Phase 2 Modernization, dated August 28, 2023, for the Project located in Wenatchee, WA for NCW Libraries, as well as the site and conditions affecting the Work, the undersigned proposes to furnish all labor and materials and perform all Work for the various parts of the construction in accordance with the Contract Documents for the following amount(s):

BASE BID

(written) Dollars

\$ _____
(numeric)

ALTERNATES

Alternate #1: Demolish high density shelving

(written) Dollars

\$ _____
(numeric)

Alternate #2: Provide new staff office

(written) Dollars

\$ _____
(numeric)

Alternate #3: Provide new staff quiet room

(written) Dollars

\$ _____
(numeric)

OVERHEAD, PROFIT & SALES TAX

All of the above bid prices include overhead and profit. They do not include Washington State Sales Tax.

EXTRA WORK

The undersigned agrees that, should any extra work be ordered, the following percentages shall be added to material and labor costs to cover overhead and profit.

Allowances to General Contractor for overhead and profit for extra work performed by the Contractor's own force:	13%
Allowance to General Contractor for overhead and profit for extra work performed by Subcontractor:	8%
Allowance to each Subcontractor (any tier) for overhead and profit for extra materials or work performed by its own forces:	13%
Allowance to each Subcontractor (any tier) for overhead and profit for extra materials or work performed by its Subcontractor of any lower tier:	8%

The above percentages shall include all overhead and incidental costs, including insurance, fees, etc., except direct labor taxes. They do not include Washington State Sales Tax.

CONTRACT AND REQUISITES

If the undersigned is notified of the acceptance of this bid within 60 calendar days after the time set for the opening of bids, they agree to execute an Agreement for the above work, for compensation computed from the above sums, on the AIA A104-2017 Standard Abbreviated Form of Agreement Between Owner and Contractor included in the Contract Documents, and to furnish Bonds, Certificates of Insurance, as required by the Specifications and Instructions to Bidders.

TIME OF COMPLETION

The undersigned agrees that the Work will be substantially complete by May 1, 2024. The undersigned further agrees to provisions for payment of liquidated damages, \$500.00 per calendar day thereafter per Article 3 of AIA A107-207 Standard Abbreviated Form of Agreement Between Owner and Contractor. The undersigned agrees that the Work will be fully completed no more than 30 calendar days after Substantial Completion, including all final paperwork.

SUBCONTRACTORS

The undersigned agrees, if awarded the Contract, to employ the following subcontractors for work listed and further agrees that the said subcontractor may not be changed without written consent of NCW Libraries.

FIELD OF WORK	SUBCONTRACTOR NAME
Electrician	_____
Plumber	_____
Mechanical Contractor	_____

ADDENDA

The undersigned hereby acknowledges receipt of the following Addenda. All costs, provisions, and requirements of which have been incorporated into this proposal:

(list each, if non received, write "none")

Legal Name of Bidding Firm

Address

Contractor's Registration Number

City

State

Zip

By: (name and title)

Phone

Signature

Title

CONTRACTOR'S QUALIFICATION STATEMENT

The undersigned certifies that the information provided herein is true and sufficiently complete as to not be misleading.

Submitted By

Name

Address

1. Organization

- a. How many years has your organization been in business as a Contractor?
- b. How many years has your organization been in business under its present business name?
 - i. Under what other names has your organization operated?
- c. If your organization is a corporation, answer the following:
 - i. Date of incorporation:
 - ii. State of incorporation:
 - iii. President's name:
 - iv. Vice President's name:
- d. If your organization is a partnership, answer the following:
 - i. Date of organization:
 - ii. Type of partnership (if applicable):
 - iii. Name(s) of partner(s):
- e. If your organization is individually owned, answer the following:
 - i. Date of organization:
 - ii. Name of owner:
- f. If the form of your organization is different than those listed above, describe it and name principals:

2. Licensing

- a. List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration of license numbers, if applicable:

3. Experience

- a. List the categories of work that your organization normally performs with its own forces.
- b. Claims and Suits.
 - i. Has your organization ever failed to complete any work awarded to it?
 - ii. Are there any judgments, claims, arbitration proceedings or suits pending or outstanding against your organization or its officers?
 - iii. Has your organization filed any lawsuits or requested arbitration with regard to construction contracts within the last five years?
- c. Within the last five years, has an officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract?
- d. On a separate sheet, list major construction projects your organization has in progress, giving the name of the project, owner, architect, contract amount, percent complete and scheduled completion date.
- e. On a separate sheet, list the major projects your organization has completed in the past five years, giving the name of the project, owner, architect, contract amount, percent complete and scheduled completion date.

4. References

- a. Please list 2-3 references per category below:
 - i. Trade References:
 - ii. Client References:
 - iii. Bank References (just one is acceptable:

5. Signature

a. Dated at _____, _____ this _____ day of _____, 2023.

b. Name of organization: _____

c. By: _____

d. Title: _____

DRAFT AIA® Document A104® – 2017

Standard Abbreviated Form of Agreement Between Owner and Contractor

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

NCW Libraries
16 North Columbia Street
Wenatchee, WA 98801
(509) 630-1117

and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

Wenatchee Public Library Phase 2 Modernization
310 Douglas Street
Wenatchee, WA 98801

The Architect:
(Name, legal status, address and other information)

BuildingWork LLC
159 Western Avenue West, Suite 486
Seattle, WA 98119
(206) 775-8668
« »

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:
The author of this document has added information and has deleted information for its completion. The author may also have revised the text of the original AIA standard form. All Additions and Deletions are noted in this document. The author is responsible for the information as well as the revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion and modification.

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ARTICLE 1 THE WORK OF THIS CONTRACT

The Contractor shall execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 2 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 2.1 The date of commencement of the Work shall be:

(Check one of the following boxes.)

- ☒ Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

Not more than (14) fourteen calendar days after execution of this Agreement.

§ 2.2 The Contract Time shall be measured from the date of commencement.

§ 2.3 Substantial Completion

§ 2.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

(Check the appropriate box and complete the necessary information.)

☐ Not later than ☐ (☐) calendar days from the date of commencement of the Work.

☒ By the following date: May 3, 2024

§ 2.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

§ 2.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 2.3, liquidated damages, if any, shall be assessed as set forth in Section 3.5.

ARTICLE 3 CONTRACT SUM

§ 3.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be one of the following:

(Check the appropriate box.)

☐ Stipulated Sum, in accordance with Section 3.2 below

☐ Cost of the Work plus the Contractor's Fee, in accordance with Section 3.3 below

☒ Cost of the Work plus the Contractor's Fee with a Guaranteed Maximum Price, in accordance with Section 3.4 below

(Based on the selection above, complete Section 3.2, 3.3 or 3.4 below.)

§ 3.4 Cost of the Work Plus Contractor's Fee With a Guaranteed Maximum Price

§ 3.4.1 The Cost of the Work is as defined in Exhibit A, Determination of the Cost of the Work.

§ 3.4.2 The Contractor's Fee:

(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee and the method of adjustment to the Fee for changes in the Work.)

Four Percent (4%)

§ 3.4.3 Guaranteed Maximum Price

§ 3.4.3.1 The sum of the Cost of the Work and the Contractor's Fee is guaranteed by the Contractor not to exceed ☐ (\$ ☐), subject to additions and deductions by changes in the Work as provided in the Contract Documents. This maximum sum is referred to in the Contract Documents as the Guaranteed Maximum Price. Costs which would cause the Guaranteed Maximum Price to be exceeded shall be paid by the Contractor without reimbursement by the Owner.

(Insert specific provisions if the Contractor is to participate in any savings.)

If Contractor achieves Substantial Completion and completes the entirety of the Work within the grace period and in accordance with the Contract Documents, the Owner and Contractor agree that Savings, defined as the Guaranteed Maximum Price (as adjusted by additions and deductions by Change Order as provided in the Contract Documents)

less actual Cost of Work, and less unused Contingency (if any), and less Contractor's Fee, will be shared in the ratio of 70% to the Owner and 30% to the Contractor.

§ 3.4.3.2 The Guaranteed Maximum Price is based on the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

« »

§ 3.4.3.3 Unit Prices, if any:

(Identify the item and state the unit price and the quantity limitations, if any, to which the unit price will be applicable.)

	Units and Limitations	Price per Unit (\$0.00)
--	-----------------------	-------------------------

§ 3.4.3.4 Allowances, if any, included in the Guaranteed Maximum Price:

(Identify each allowance.)

	Price
--	-------

§ 3.4.3.5 Assumptions, if any, on which the Guaranteed Maximum Price is based:

« »

§ 3.4.3.6 To the extent that the Contract Documents are anticipated to require further development, the Guaranteed Maximum Price includes the costs attributable to such further development consistent with the Contract Documents and reasonably inferable therefrom. Such further development does not include changes in scope, systems, kinds and quality of materials, finishes or equipment, all of which, if required, shall be incorporated by Change Order.

§ 3.4.3.7 The Owner shall authorize preparation of revisions to the Contract Documents that incorporate the agreed-upon assumptions contained in Section 3.4.3.5. The Owner shall promptly furnish such revised Contract Documents to the Contractor. The Contractor shall notify the Owner and Architect of any inconsistencies between the agreed-upon assumptions contained in Section 3.4.3.5 and the revised Contract Documents.

§ 3.5 Liquidated damages, if any:

(Insert terms and conditions for liquidated damages, if any.)

\$500.00 per calendar day after May 3, 2024.

ARTICLE 4 PAYMENT

§ 4.1 Progress Payments

§ 4.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 4.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month.

§ 4.1.3 Provided that an Application for Payment is received by the Owner not later than the last Wednesday of a month, the Owner shall make payment of the certified amount to the Contractor not later than the 20th day of the

same month. If an Application for Payment is received by the Architect after the date fixed above, payment shall be made by the Owner not later than **thirty (30)** days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 4.1.4 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold retainage from the payment otherwise due as follows:

(Insert a percentage or amount to be withheld as retainage from each Application for Payment and any terms for reduction of retainage during the course of the Work. The amount of retainage may be limited by governing law.)

Five percent (5%)

§ 4.1.5 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

1% (one percent)

§ 4.2 Final Payment

§ 4.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 18.2, and to satisfy other requirements, if any, which extend beyond final payment;
- .2 the Contractor has submitted a final accounting for the Cost of the Work, where payment is on the basis of the Cost of the Work with or without a Guaranteed Maximum Price; and
- .3 a final Certificate for Payment has been issued by the Architect in accordance with Section 15.7.1.

§ 4.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

As described in the Specifications

ARTICLE 5 DISPUTE RESOLUTION

§ 5.1 Binding Dispute Resolution

For any claim subject to, but not resolved by, mediation pursuant to Section 21.5, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

☒ [X] Litigation in a Chelan County Superior Court

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, claims will be resolved in a court of competent jurisdiction.

ARTICLE 6 ENUMERATION OF CONTRACT DOCUMENTS

§ 6.1 The Contract Documents are defined in Article 7 and, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 6.1.1 The Agreement is this executed AIA Document A104™-2017, Standard Abbreviated Form of Agreement Between Owner and Contractor.

§ 6.1.2 AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:

(Insert the date of the E203-2013 incorporated into this Agreement.)

N/A

§ 6.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
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§ 6.1.4 The Specifications:

(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

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§ 6.1.5 The Drawings:

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

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§ 6.1.6 The Addenda, if any:

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are enumerated in this Article 6.

§ 6.1.7 Additional documents, if any, forming part of the Contract Documents:

.1 Other Exhibits:

(Check all boxes that apply.)

[☐] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
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.2 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents.)

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ARTICLE 7 GENERAL PROVISIONS

§ 7.1 The Contract Documents

The Contract Documents are enumerated in Article 6 and consist of this Agreement (including, if applicable, Supplementary and other Conditions of the Contract), Drawings, Specifications, Addenda issued prior to the execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 7.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind between any persons or entities other than the Owner and the Contractor.

§ 7.3 The Work

The term “Work” means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations. The Work may constitute the whole or a part of the Project.

§ 7.4 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect’s consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 7.5 Ownership and use of Drawings, Specifications and Other Instruments of Service

§ 7.5.1 The Architect and the Architect’s consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect’s or Architect’s consultants’ reserved rights.

§ 7.5.2 The Contractor, Subcontractors, Sub-subcontractors and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to the protocols established pursuant to Sections 7.6 and 7.7, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect’s consultants.

§ 7.6 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form.

§ 7.8 Severability

The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties’ intentions and purposes in executing the Contract.

§ 7.9 Notice

§ 7.9.1 Except as otherwise provided in Section 7.9.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission, or as otherwise set forth below:

(If other than in accordance with AIA Document E203–2013, insert requirements for delivering Notice in electronic format such as name, title and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 7.9.2 Notice of Claims shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 7.10 Relationship of the Parties

Where the Contract is based on the Cost of the Work plus the Contractor's Fee, with or without a Guaranteed Maximum Price, the Contractor accepts the relationship of trust and confidence established by this Agreement and covenants with the Owner to cooperate with the Architect and exercise the Contractor's skill and judgment in furthering the interests of the Owner; to furnish efficient business administration and supervision; to furnish at all times an adequate supply of workers and materials; and to perform the Work in an expeditious and economical manner consistent with the Owner's interests. The Owner agrees to furnish and approve, in a timely manner, information required by the Contractor and to make payments to the Contractor in accordance with the requirements of the Contract Documents.

ARTICLE 8 OWNER

§ 8.1 Information and Services Required of the Owner

§ 8.1.1 Prior to commencement of the Work, at the written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 8.1.1, the Contract Time shall be extended appropriately.

§ 8.1.2 The Owner shall furnish all necessary surveys and a legal description of the site.

§ 8.1.3 The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 8.1.4 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 9.6.1, the Owner shall secure and pay for other necessary approvals, easements, assessments, and charges required for the construction, use, or occupancy of permanent structures or for permanent changes in existing facilities.

§ 8.2 Owner's Right to Stop the Work

If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents, or repeatedly fails to carry out the Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order is eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

§ 8.3 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents, and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to any other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 15.4.3, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including the Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 21.

ARTICLE 9 CONTRACTOR

§ 9.1 Review of Contract Documents and Field Conditions by Contractor

§ 9.1.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 9.1.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 8.1.2, shall take field measurements of any existing conditions related to that portion of the Work and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies, or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.

§ 9.1.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 9.2 Supervision and Construction Procedures

§ 9.2.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters.

§ 9.2.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for or on behalf of the Contractor or any of its Subcontractors.

§ 9.3 Labor and Materials

§ 9.3.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 9.3.2 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

§ 9.3.3 The Contractor may make a substitution only with the consent of the Owner, after evaluation by the Architect and in accordance with a Modification.

§ 9.4 Warranty

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation or normal wear and tear under normal usage. All other warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 15.6.3.

§ 9.5 Taxes

The Contractor shall pay sales, consumer, use, and other similar taxes that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 9.6 Permits, Fees, Notices, and Compliance with Laws

§ 9.6.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as other permits, fees, licenses, and inspections by government agencies necessary for proper

execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 9.6.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work. If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 9.8 Contractor's Construction Schedules

§ 9.8.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 9.8.2 The Contractor shall perform the Work in general accordance with the most recent schedule submitted to the Owner and Architect.

§ 9.9 Submittals

§ 9.9.1 The Contractor shall review for compliance with the Contract Documents and submit to the Architect Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents in coordination with the Contractor's construction schedule and in such sequence as to allow the Architect reasonable time for review. By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them; (2) determined and verified materials, field measurements, and field construction criteria related thereto, or will do so; and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. The Work shall be in accordance with approved submittals.

§ 9.9.2 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents.

§ 9.9.3 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents or unless the Contractor needs to provide such services in order to carry out the Contractor's own responsibilities. If professional design services or certifications by a design professional are specifically required, the Owner and the Architect will specify the performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional. If no criteria are specified, the design shall comply with applicable codes and ordinances. Each Party shall be entitled to rely upon the information provided by the other Party. The Architect will review and approve or take other appropriate action on submittals for the limited purpose of checking for conformance with information provided and the design concept expressed in the Contract Documents. The Architect's review of Shop Drawings, Product Data, Samples, and similar submittals shall be for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. In performing such review, the Architect will approve, or take other appropriate action upon, the Contractor's Shop Drawings, Product Data, Samples, and similar submittals.

§ 9.10 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 9.11 Cutting and Patching

The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

§ 9.12 Cleaning Up

The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus material from and about the Project.

§ 9.13 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 9.14 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 9.15 Indemnification

§ 9.15.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 9.15.1.

§ 9.15.2 In claims against any person or entity indemnified under this Section 9.15 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 9.15.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 10 ARCHITECT

§ 10.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction, until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with other provisions of the Contract.

§ 10.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 10.3 The Architect will visit the site at intervals appropriate to the stage of the construction to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general, if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 10.4 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the

Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 10.5 Based on the Architect's evaluations of the Work and of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 10.6 The Architect has authority to reject Work that does not conform to the Contract Documents and to require inspection or testing of the Work.

§ 10.7 The Architect will review and approve or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 10.8 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect will make initial decisions on all claims, disputes, and other matters in question between the Owner and Contractor but will not be liable for results of any interpretations or decisions rendered in good faith.

§ 10.9 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

ARTICLE 11 SUBCONTRACTORS

§ 11.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site.

§ 11.2 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the Subcontractors or suppliers proposed for each of the principal portions of the Work. The Contractor shall not contract with any Subcontractor or supplier to whom the Owner or Architect has made reasonable written objection within ten days after receipt of the Contractor's list of Subcontractors and suppliers. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 11.3 Contracts between the Contractor and Subcontractors shall (1) require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by the Contract Documents, assumes toward the Owner and Architect, and (2) allow the Subcontractor the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Contract Documents, has against the Owner.

ARTICLE 12 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 12.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 12.2 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's activities with theirs as required by the Contract Documents.

§ 12.3 The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a Separate Contractor because of delays, improperly timed activities, or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs incurred by the Contractor because of delays, improperly timed activities, damage to the Work, or defective construction of a Separate Contractor.

ARTICLE 13 CHANGES IN THE WORK

§ 13.1 By appropriate Modification, changes in the Work may be accomplished after execution of the Contract. The Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, with the Contract Sum and Contract Time being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Owner, Contractor, and Architect, or by written Construction Change Directive signed by the Owner and Architect. Upon issuance of the Change Order or Construction Change Directive, the Contractor shall proceed promptly with such changes in the Work, unless otherwise provided in the Change Order or Construction Change Directive.

§ 13.2 Adjustments in the Contract Sum and Contract Time resulting from a change in the Work shall be determined by mutual agreement of the parties or, in the case of a Construction Change Directive signed only by the Owner and Architect, by the Contractor's cost of labor, material, equipment, and reasonable overhead and profit, unless the parties agree on another method for determining the cost or credit. Pending final determination of the total cost of a Construction Change Directive, the Contractor may request payment for Work completed pursuant to the Construction Change Directive. The Architect will make an interim determination of the amount of payment due for purposes of certifying the Contractor's monthly Application for Payment. When the Owner and Contractor agree on adjustments to the Contract Sum and Contract Time arising from a Construction Change Directive, the Architect will prepare a Change Order.

§ 13.3 The Architect will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work.

§ 13.4 If concealed or unknown physical conditions are encountered at the site that differ materially from those indicated in the Contract Documents or from those conditions ordinarily found to exist, the Contract Sum and Contract Time shall be equitably adjusted as mutually agreed between the Owner and Contractor; provided that the Contractor provides notice to the Owner and Architect promptly and before conditions are disturbed.

ARTICLE 14 TIME

§ 14.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing this Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 14.2 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 14.3 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 14.4 The date of Substantial Completion is the date certified by the Architect in accordance with Section 15.6.3.

§ 14.5 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) changes ordered in the Work; (2) by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions not reasonably anticipatable, unavoidable casualties, or any causes beyond the Contractor's control; or (3) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine, subject to the provisions of Article 21.

ARTICLE 15 PAYMENTS AND COMPLETION

§ 15.1 Schedule of Values

§ 15.1.1 The Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Guaranteed Maximum Price to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy required by the Architect. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 15.1.2 The allocation of the Guaranteed Maximum Price under this Section 15.1 shall not constitute a separate stipulated sum or guaranteed maximum price for each individual line item in the schedule of values.

§ 15.3 Applications for Payment

§ 15.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 15.1, for completed portions of the Work. The application shall be notarized, if required; be supported by all data substantiating the Contractor's right to payment that the Owner or Architect require; shall reflect retainage if provided for in the Contract Documents; and include any revised cost control information required by Section 15.2.4. Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 15.3.2 With each Application for Payment where the Contract Sum is based upon the Cost of the Work, or the Cost of the Work with a Guaranteed Maximum Price, the Contractor shall submit payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached, and any other evidence required by the Owner to demonstrate that cash disbursements already made by the Contractor on account of the Cost of the Work equal or exceed progress payments already received by the Contractor plus payrolls for the period covered by the present Application for Payment, less that portion of the progress payments attributable to the Contractor's Fee.

§ 15.3.3 Payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment stored, and protected from damage, off the site at a location agreed upon in writing.

§ 15.3.4 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or other encumbrances adverse to the Owner's interests.

§ 15.4 Certificates for Payment

§ 15.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner of the Architect's reasons for withholding certification in whole or in part as provided in Section 15.4.3.

§ 15.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluations of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 15.4.3 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 15.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 15.4.1. If the Contractor and the Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 9.2.2, because of

- .1 defective Work not remedied;
- .2 third-party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 15.4.4 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 15.4.3, in whole or in part, that party may submit a Claim in accordance with Article 21.

§ 15.5 Progress Payments

§ 15.5.1 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to sub-subcontractors in a similar manner.

§ 15.5.2 Neither the Owner nor Architect shall have an obligation to pay or see to the payment of money to a Subcontractor or supplier except as may otherwise be required by law.

§ 15.5.3 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 15.5.4 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 15.6 Substantial Completion

§ 15.6.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 15.6.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 15.6.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. When the Architect determines that the Work or designated

portion thereof is substantially complete, the Architect will issue a Certificate of Substantial Completion which shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 15.6.4 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 15.7 Final Completion and Final Payment

§ 15.7.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions stated in Section 15.7.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 15.7.2 Final payment shall not become due until the Contractor has delivered to the Owner a complete release of all liens arising out of this Contract or receipts in full covering all labor, materials and equipment for which a lien could be filed, or a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including costs and reasonable attorneys' fees.

§ 15.7.3 The making of final payment shall constitute a waiver of claims by the Owner except those arising from

- .1 liens, claims, security interests or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 15.7.4 Acceptance of final payment by the Contractor, a Subcontractor or supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of the final Application for Payment.

ARTICLE 16 PROTECTION OF PERSONS AND PROPERTY

§ 16.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation, or replacement in the course of construction.

The Contractor shall comply with, and give notices required by, applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons and property and their protection from damage, injury, or loss. The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, a Subcontractor, a sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 16.1.2 and 16.1.3. The Contractor may make a claim for the cost to remedy the damage

or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 9.15.

§ 16.2 Hazardous Materials and Substances

§ 16.2.1 The Contractor is responsible for compliance with the requirements of the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents, and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 16.2.2 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area, if in fact, the material or substance presents the risk of bodily injury or death as described in Section 16.2.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 16.2.3 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

ARTICLE 17 INSURANCE AND BONDS

§ 17.1 Contractor's Insurance

§ 17.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in this Section 17.1 or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the insurance required by this Agreement from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 18.4, unless a different duration is stated below:

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§ 17.1.2 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than one million (\$ 1,000,000.00) each occurrence, one million (\$ 1,000,000.00) general aggregate, and one million (\$ 1,000,000.00) aggregate for products-completed operations hazard, providing coverage for claims including

- .1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;
- .2 personal and advertising injury;
- .3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
- .4 bodily injury or property damage arising out of completed operations; and
- .5 the Contractor's indemnity obligations under Section 9.15.

§ 17.1.3 Automobile Liability covering vehicles owned by the Contractor and non-owned vehicles used by the Contractor, with policy limits of not less than one million (\$ 1,000,000.00) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance, and use of those motor vehicles along with any other statutorily required automobile coverage.

§ 17.1.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such

primary and excess or umbrella insurance policies result in the same or greater coverage as those required under Section 17.1.2 and 17.1.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ 17.1.5 Workers' Compensation at statutory limits.

§ 17.1.6 Employers' Liability with policy limits not less than **one million (\$ 1,000,000.00)** each accident, **one million (\$ 1,000,000.00)** each employee, and **two million (\$ 2,000,000.00)** policy limit.

§ 17.1.7 If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than **one million (\$ 1,000,000.00)** per claim and **two million (\$ 2,000,000.00)** in the aggregate.

§ 17.1.8 If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than **one million (\$ 1,000,000.00)** per claim and **two million (\$ 2,000,000.00)** in the aggregate.

§ 17.1.9 Coverage under Sections 17.1.7 and 17.1.8 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than **one million (\$ 1,000,000.00)** per claim and **two million (\$ 2,000,000.00)** in the aggregate.

§ 17.1.10 The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Section 17.1 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the period required by Section 17.1.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy.

§ 17.1.11 The Contractor shall disclose to the Owner any deductible or self- insured retentions applicable to any insurance required to be provided by the Contractor.

§ 17.1.12 To the fullest extent permitted by law, the Contractor shall cause the commercial liability coverage required by this Section 17.1 to include (1) the Owner, the Architect, and the Architect's Consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's Consultants, CG 20 32 07 04.

§ 17.1.13 Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by this Section 17.1, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 17.1.14 Other Insurance Provided by the Contractor

(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

§ 17.2 Owner's Insurance

§ 17.2.1 Owner's Liability Insurance

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 17.2.2 Property Insurance

§ 17.2.2.1 The Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed or materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section 17.2.2.2, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

§ 17.2.2.2 Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section 17.2.2.1 or, if necessary, replace the insurance policy required under Section 17.2.2.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 18.4.

§ 17.2.2.3 If the insurance required by this Section 17.2.2 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.

§ 17.2.2.4 If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 18.4, "all-risks" property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

§ 17.2.2.5 Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Section 17.2.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by this Section 17.2.2. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

§ 17.2.2.6 Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any insurance required by this Section 17.2.2, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 17.2.2.7 Waiver of Subrogation

§ 17.2.2.7.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by this Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this Section 17.2.2.7 shall not prohibit this waiver of subrogation. This waiver

of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 17.2.2.7.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 17.2.2.7.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 17.2.2.8 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements, written where legally required for validity, the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 17.2.3 Other Insurance Provided by the Owner

(List below any other insurance coverage to be provided by the Owner and any applicable limits.)

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Limits

§ 17.3 Performance Bond and Payment Bond

§ 17.3.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in the Contract Documents on the date of execution of the Contract.

§ 17.3.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 18 CORRECTION OF WORK

§ 18.1 The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed, or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 18.2 In addition to the Contractor's obligations under Section 9.4, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 15.6.3, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty.

§ 18.3 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it in accordance with Section 8.3.

§ 18.4 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 18.5 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Article 18.

ARTICLE 19 MISCELLANEOUS PROVISIONS

§ 19.1 Assignment of Contract

Neither party to the Contract shall assign the Contract without written consent of the other, except that the Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 19.2 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 21.6.

§ 19.3 Tests and Inspections

Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 19.4 The Owner's representative:

(Name, address, email address and other information)

Amanda Lawson
NCW Libraries, Facilities Manager
16 North Columbia Street
Wenatchee, WA 98801
509-630-2176
alawson@ncwlibraries.org

§ 19.5 The Contractor's representative:

(Name, address, email address and other information)

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§ 19.6 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 19.7 Prevailing Wage

This agreement is subject to prevailing wages according to RCW 39.12.020. The Vendor shall file an Intent to Pay Prevailing Wage form and Affidavit of Wages paid for, with the Washington State Department of Labor and Industries and pay for all fees associated with filing the forms. Vendor shall submit the Intent and Affidavit forms, approved by Washington State Department of Labor and Industries to Owner with the final invoice for the Work. No payment will be issued to the Vendor until the Owner received the approved forms. If any Work is subcontracted, an approved Intent and Affidavit form must be submitted for each subcontractor. If progress payments are made for this

scope of Work, an approved Intent form must be received prior to issuing the first payment. An approved Affidavit form must be received prior to issuing final payment.

§ 19.8 Access to Records

The Owner and authorized representatives of the State and Federal Governments shall have access to any books, documents, papers, and records of the Contractor which are pertinent to this Agreement for the purposes of making audits, examination, excerpts, and transcriptions. All such records and all other records pertinent to this Agreement and Work undertaken pursuant to this Agreement shall be retained for a period of six (6) years after completion and acceptance of the Work by Owner, unless a longer period is required to resolve audit findings or litigation. In such cases, Owner may request, and the Contractor shall abide by, such longer period for record retention.

§ 19.9 Independent Contractor

The Contractor and Owner agree that the Contractor is an independent contractor with respect to the Work performed or services provided pursuant to this Agreement. Nothing in this Agreement shall be considered to create the relationship of employer and employee between the parties hereto. Neither Contractor nor any employee or subcontractor shall be entitled to any benefits afforded to Owner's employees by virtue of the services provided under this Agreement.

ARTICLE 20 TERMINATION OF THE CONTRACT

§ 20.1 Termination by the Contractor

If the Architect fails to certify payment as provided in Section 15.4.1 for a period of 30 days through no fault of the Contractor, or if the Owner fails to make payment as provided in Section 4.1.3 for a period of 30 days, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 20.2 Termination by the Owner for Cause

§ 20.2.1 The Owner may terminate the Contract if the Contractor

- .1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2** fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 20.2.2 When any of the reasons described in Section 20.2.1 exists, the Owner, upon certification by the Architect that sufficient cause exists to justify such action, may, without prejudice to any other remedy the Owner may have and after giving the Contractor seven days' notice, terminate the Contract and take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor and may finish the Work by whatever reasonable method the Owner may deem expedient. Upon request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 20.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 20.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 20.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect, upon application, and this obligation for payment shall survive termination of the Contract.

§ 20.3 Termination by the Owner for Convenience

The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause. The Owner shall pay the Contractor for Work executed; and costs incurred by reason of such termination, including costs attributable to termination of Subcontracts; and a termination fee, if any, as follows:

(Insert the amount of or method for determining the fee payable to the Contractor by the Owner following a termination for the Owner's convenience, if any.)

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ARTICLE 21 CLAIMS AND DISPUTES

§ 21.1 Claims, disputes, and other matters in question arising out of or relating to this Contract, including those alleging an error or omission by the Architect but excluding those arising under Section 16.2, shall be referred initially to the Architect for decision. Such matters, except those waived as provided for in Section 21.11 and Sections 15.7.3 and 15.7.4, shall, after initial decision by the Architect or 30 days after submission of the matter to the Architect, be subject to mediation as a condition precedent to binding dispute resolution.

§ 21.2 Notice of Claims

§ 21.2.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 18.2, shall be initiated by notice to the Architect within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 21.2.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 18.2, shall be initiated by notice to the other party.

§ 21.3 Time Limits on Claims

The Owner and Contractor shall commence all claims and causes of action against the other and arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in this Agreement whether in contract, tort, breach of warranty, or otherwise, within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 21.3.

§ 21.4 If a claim, dispute or other matter in question relates to or is the subject of a mechanic's lien, the party asserting such matter may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 21.5 The parties shall endeavor to resolve their disputes by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with their Construction Industry Mediation Procedures in effect on the date of this Agreement. A request for mediation shall be made in writing, delivered to the other party to this Agreement, and filed with the person or entity administering the mediation. The request may be made concurrently with the binding dispute resolution but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 21.6 If the parties have selected arbitration as the method for binding dispute resolution in this Agreement, any claim, subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association, in accordance with the Construction Industry Arbitration Rules in effect on the date of this Agreement. Demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 21.7 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation; (2) the arbitrations to be consolidated substantially involve common questions of law or fact; and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 21.8 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, any party to an arbitration may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of a Claim not described in the written Consent.

§ 21.9 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to this Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 21.10 Continuing Contract Performance

Pending final resolution of a Claim, except as otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 21.11 Waiver of Claims for Consequential Damages

The Contractor and Owner waive claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 20. Nothing contained in this Section 21.11 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

This Agreement entered into as of the day and year first written above.

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Work by Owner.
 - 4. Access to site.
 - 5. Work restrictions.
 - 6. Specification and Drawing conventions.
 - 7. Miscellaneous provisions.

- B. Related Requirements:

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

1.3 PROJECT INFORMATION

- A. Project Identification: **Wenatchee Public Library Modernization Phase 2.**

- 1. Project Location: 310 Douglas Street
Wenatchee, Washington 98801

- B. Owner: **NCW Libraries** 16 North Columbia
Street Wenatchee, Washington 98801

1. Owner's Representative: **Amanda Lawson**
Facilities Manger
310 Douglas Street
Wenatchee, Washington 98801
(509) 660-2176

alawson@ncwlibraries.org

- C. Architect: **BuildingWork**
159 Western Ave. W., Ste. 486
Seattle, Washington 98801
Attention: Kate Weiland AIA
(206) 75-8672

kate@buildingwork.design

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

1. ELECTRICAL ENGINEER: KWR Electrical Consulting and Design
Attn: Aaron Whiting
5915 S Regal Street Suite 201
Spokane, WA 99233
509-473-9218
aaron@KWRLLC.com

2. MECHANICAL ENGINEER: Kartchner Engineering
Attn: Sydney Harmon
101 S Stevens Street Suite 201
Spokane, WA 99201
509-922-0380
sydneyh@kartchnerengineering.com

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

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

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
The project will consist of modernization and remodel of the existing
Wenatchee Regional Library building located at 310 Douglas Street, in

Wenatchee Public Library Phase 2 Modernization
NCW Libraries

Wenatchee includes but is not limited to:

- Demolition of existing non-structural partitions and finishes as described in the contract documents;
- New finishes at lower levels of the building;
- New interior storefront and framed walls to redefine space on the lower level;
- New exterior windows at the existing lower level meeting room;
- Reconfiguration and replacement of shelves and other fixtures;
- Relocation and reconfiguration of staff work and break areas;
- New finishes and casework at the lower mezzanine;
- Reconfiguration of lower level;
- New single-user restroom at currently location of multi-user restroom at lower level
- Associated mechanical, plumbing, fire alarm, and electrical work

1. and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.
 - a. AIA A104 – 2017 Abbreviated Form of Agreement Between Owner and Contractor.

1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
 1. Relocation of all library functions and materials.

1.6 ACCESS TO SITE

- A. General: Contractor shall have full use of areas within the scope of work 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. Limits: Confine construction operations to area indicated on Drawings.
 2. Driveways, Walkways and Entrances: Keep driveways 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 for storage of materials.

- a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- 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 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 seven a.m. to six p.m., Monday through Friday, unless otherwise indicated.
- 1. Weekend Hours: As required and with prior approval.
 - 2. Early Morning Hours: As required and with prior approval.
- C. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
- 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on

Drawings to identify materials and products:

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.

- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Demolish high density shelving.
 - 1. Base Bid: No work.
 - 2. Alternate: Removal of high density shelving at staff work room sorting/work area 005. Removal to include disposal of all shelving, and repair of adjacent surfaces and finishes.
- B. Alternate No. 2: Provide new staff office.
 - 1. Base Bid: No work to staff work areas.
 - 2.
 - 3. Alternate: Construct new Office 007 in the staff work room per plans. Relocate MEPF as necessary.
- C. Alternate No. 3: Provide new quiet room.
 - 1. Base Bid: No work.
 - 2. Alternate: Remove and reconfigure existing wall between children's and the hallway to the staff work room to extent noted. Removed and reinstall existing shelving in children's area as required to accomplish scope of work. Construct new Quiet Room 008 per plan and adjust MEPF as necessary. Patch flooring in children's area as required. Repaint wall in children's base color to match existing mural.

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES PART

1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 01 23 00 "Alternates" for products selected under an alternate.
 - 2. 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: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 13.1A or similar.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or 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 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.
 - 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.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

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

Architect will return requests without action, except to record noncompliance with these requirements:

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

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 ARCHITECT'S SUPPLEMENTAL INSTRUCTION (ASI)

- A. Prepared by Architect.
- B. Form provided by Architect.
- C. Form will be clearly marked with one of the following options:
 - 1. The work described herein is a clarification of the Contract Documents. Proceeding with the work indicates your acknowledgement that there will be no change in the Contract Sum or Contract Time.
 - 2. You are hereby directed to proceed as outlined herein. Submit an itemized proposal for change (Increase or decrease) in the Contract Sum & Contract Time, prepared in accordance with the General & Supplementary General Conditions of the Contract, within (7) days. A formal Change Order will be issued after approval of the proposal by the Owner & the Architect.
 - 3. You are NOT authorized to proceed with this work. Submit an itemized proposal for changes (Increase or Decrease) in the Contract Sum and Contract Time, prepared in accordance with the General and Supplementary General Conditions of the Contract, within (7) days.
 - 4. You are hereby directed to proceed with the work herein, to be performed on a T/M basis; General Contractor's overhead and profit shall be per the

OWNER/CONTRACTOR agreement. Submit a proposal for changes in Contract Time, if any, within (7) days.

- D. Acceptance by Owner required prior to issuance to Contractor.
- E. Transmitted to Contractor for signature.
- F. Contractor must either:
 - 1. Proceed upon receipt.
 - 2. Submit a statement of cost impact as a COP within 7 days of receipt.
 - a. If cost impact is justified, Owner will acknowledge the COP and include in the next issued Change Order.
 - b. If cost impact is not justified, Owner will issue a Notice to Proceed, directing the Contractor to proceed with the work in question, with no change to the Contract sum.
- G. Architect's Supplemental Instructions shall be numbered consecutively. Reissued ASIs shall be given decimal extensions (e.g. 17.1).
- H. Changes shall be recorded weekly by contractor on record drawings and specifications.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue via ASI as described above as form option number 3.
 - 1. ASIs issued by Architect marked as form option # 3 are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 7 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

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

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. 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. Multiple Change Order Proposals may be consolidated to a single Change Order.

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 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES PART

1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 22 00 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 2. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. 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 ten 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 schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - a. 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.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

- a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
 1. Submit draft copy of Application for Payment five days prior to due date for review by Architect.
- C. Application for Payment Forms: Use AIA Document **G732-2019** and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. 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 one digital, notarized copy of each Application for Payment to Architect and Owner via dedicated location on cloud-based project portal. This file shall include waivers of lien and similar attachments if required. The file is not to be locked so digital signatures by architect and owner may be added.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Submittal schedule (preliminary if not final).
 5. List of Contractor's staff assignments.
 6. List of Contractor's principal consultants.
 7. Washington State Department of Labor and Industries Intent to Pay Prevailing Wages for General Contractor and all subcontractors.
 8. Copies of permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Not used.
 12. Certificates of insurance and insurance policies.
 13. Performance and payment bonds.

- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 1. Evidence of completion of Project closeout requirements.
 2. 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. Washington State Department of Labor and Industries Affidavit of Wages Paid for General Contractor and all subcontractors.
 5. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 6. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 7. AIA Document G707, "Consent of Surety to Final Payment."
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 10. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION PART

1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project Portal.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

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

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, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

- 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.

1.5 GENERAL COORDINATION PROCEDURES

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

3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 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.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow five working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log at project meetings. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.7 PROJECT WEB SITE

- A. The contractor is responsible for setting up and maintaining a cloud-based construction project management and document sharing portal through the duration of the project. This portal or site must have the capabilities to notify team members of any posting, and allow team members to upload documents up to 100mb large. Each upload must be time and date stamped and be accessible to all team members through the shared portal.
 - 1. Acceptable systems include Procore, Newforma, and Primavera Submittal Exchange. Alternate systems and softwares will be reviewed by architect and owner for appropriateness
- B. Use Project portal site for purposes of hosting and managing project communication and documentation until Final Completion. Project portal site shall include the following:
 - 1. Project directory.
 - 2. Project correspondence.
 - 3. Meeting minutes.
 - 4. Contract modifications forms and logs.
 - 5. RFI forms and logs.
 - 6. Task and issue management.
 - 7. Photo documentation.
 - 8. Submittals.
 - 9. Submittals forms and logs.
 - 10. Payment application forms.
 - 11. Drawing and specification document hosting, viewing, and updating.
- C. Owner, Architect, and Architect's subconsultants must be granted access by Contractor to Project portal site.

1.8 PROJECT MEETINGS

- A. General: Contractor is to schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Contractor, but no later than 5 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, and their consultants; Contractor and its superintendent; major

subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Sustainable design requirements.
 - m. Preparation of record documents.
 - n. Use of the premises and existing building.
 - o. Work restrictions.
 - p. Working hours.
 - q. Owner's occupancy requirements.
 - r. Responsibility for temporary facilities and controls.
 - s. Procedures for moisture and mold control.
 - t. Procedures for disruptions and shutdowns.
 - u. Construction waste management and recycling.
 - v. Parking availability.
 - w. Office, work, and storage areas.
 - x. Equipment deliveries and priorities.
 - y. First aid.
 - z. Security.
 - aa. Progress cleaning.
 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.

- b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: Representatives of Owner, Architect, and Contractor. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review 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.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION PART

1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's construction schedule.
 - 2. Construction schedule updating reports.
 - 3. Daily construction reports.
 - 4. Material location reports.
 - 5. Site condition reports.
 - 6. Special reports.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
 - 2. 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. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
 - 3. Two paper copies.
- B. 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, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.
- D. Daily Construction Reports: Submit at weekly intervals.
- E. Material Location Reports: Submit at monthly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. 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 the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Discuss constraints, including work stages interim milestones and Owner occupancy.

3. Review delivery dates for Owner-furnished products.
4. Review schedule for work of Owner's separate contracts.
5. Review submittal requirements and procedures.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
9. Review and finalize list of construction activities to be included in schedule.
10. Review procedures for updating schedule.

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Timeframe: Extend schedule from date established for commencement of the Work to date of final completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 30 days, unless specifically allowed by Architect.
 2. 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.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. 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.
 2. 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.
 3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Provisions for future construction.
 - c. Seasonal variations.
 - d. Environmental control.
 4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 5. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.

- e. Completion of electrical installation.
 - f. Substantial Completion.
 - D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion[.]
 - E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and 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.
- 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)
- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart- type, Contractor's construction schedule within 15 days of date established for commencement of the Work. Base schedule on the startup construction schedule and additional information received since the start of Project.
 - B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 25 percent increments within time bar.
- 2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)
- A. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM schedule for the Work.

1. 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's approval of the schedule.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- B. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and commissioning.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

- C. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- D. Initial Issue of Schedule: Prepare a CPM schedule. 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.
 - 9. Average size of workforce.
 - 10. Dollar value of activity (coordinated with the schedule of values).
- E. 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.

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

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. 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 one week before each regularly scheduled progress meeting.
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-

independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
1. Architect will furnish Contractor one set of digital data drawing files in PDF format of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 2. Upon request and with completion of a CAD release form provided by the Architect, Architect will provide one set of building floor and reflected ceiling plans in AutoCAD DWG and/or .IFC format. CAD files of architectural details will not be provided.

- a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Contractor is responsible for verification of all dimensions and actual field conditions and integration of coordinated information from all subcontractors and suppliers. The contractor or its suppliers are not to rely on the CAD drawing accuracy or completeness.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 10 working days for review of each resubmittal.
- D. 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 submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., CPA- 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., CPA-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Transmittal number, numbered consecutively.
 - p. Submittal and transmittal distribution record.
 - q. Other necessary identification.
 - r. Remarks.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals: Make resubmittals in same form 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 "No Exceptions Taken, Note Markings, or Confirm Intent to Conform to Markings and Remarks" by the Architect from Architect's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Post electronic submittals as PDF electronic files directly to contractor's project portal specifically established for Project.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying

Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. PDF electronic file.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 24 by 36 inches.
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
- D. Samples: Submit (3) physical Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time

- of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
- a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- E. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."
- F. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 "Payment Procedures."
- G. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."
- H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."
- I. Maintenance Data: Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."
- J. 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.
- K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- L. 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.
- M. 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.
- N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- P. 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.

- Q. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- R. 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.
- S. 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.
- T. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- U. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 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's review is qualified by the following language included on the review stamp: "This review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawing during this review do not relieve the contractor from compliance with the requirements of the plans and specifications. No exception to a specific item does not imply no exception to an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication process or to the means, methods, techniques, sequences, and procedures of construction; coordination of the Work with that of all other trades and for performing all work in a safe and satisfactory manner."
- 1. Any action shown is subject to Contract Document's requirements. Architect will mark the review submittal in one of the following boxes on review stamp:
 - ☐ Not Required for Review
 - ☐ No Exceptions Taken
 - ☐ Make Corrections Noted
 - ☐ Revise & Resubmit
- 2. Architect / Engineer review of individual or separate items does not constitute review of assembly in which it functions.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.
- F. If Contractor believes compliance with notations, additions or deletion made by Architect and its consultants will affect Contract Cost or Time, written notification of same with supporting documentation shall be provided within seven days of return of submittal.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, 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.

1.3 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. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- 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. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. 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).
- I. 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. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

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

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

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.

- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement that equipment complies with requirements.
 - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 4. Statement whether conditions, products, and installation will affect warranty.
 - 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. 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. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to 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.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Payment for these services will be made directly to the Testing and Inspection Agency from the Owner.
 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 required to verify that the Work complies with requirements, whether specified or not.
 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in 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. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality- assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
- B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
 1. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Submitting a certified written report of each test, inspection, and similar quality- control service to Architect with copy to Contractor and to authorities having jurisdiction.
 3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

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

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

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

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as

if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- 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.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 4. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
 - 5. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 6. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 7. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 - 8. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 9. AI - Asphalt Institute; www.asphaltinstitute.org.
 - 10. AIA - American Institute of Architects (The); www.aia.org.
 - 11. AISC - American Institute of Steel Construction; www.aisc.org.
 - 12. AISI - American Iron and Steel Institute; www.steel.org.
 - 13. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 - 14. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 - 15. ANSI - American National Standards Institute; www.ansi.org.
 - 16. APA - APA - The Engineered Wood Association; www.apawood.org.
 - 17. APA - Architectural Precast Association; www.archprecast.org.
 - 18. API - American Petroleum Institute; www.api.org.
 - 19. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
 - 20. ARI - American Refrigeration Institute; (See AHRI).
 - 21. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.

22. ASCE - American Society of Civil Engineers; www.asce.org.
23. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
24. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
25. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
26. ASTM - ASTM International; (American Society for Testing and Materials International); www.astm.org.
27. AWI - Architectural Woodwork Institute; www.awinet.org.
28. AWPA - American Wood Protection Association; (Formerly: American Wood-Preservers' Association); www.awpa.com.
29. AWS - American Welding Society; www.aws.org.
30. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
31. CDA - Copper Development Association; www.copper.org.
32. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
33. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
34. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
35. CPA - Composite Panel Association; www.pbmdf.com.
36. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
37. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
38. CSI - Construction Specifications Institute (The); www.csinet.org.
39. CWC - Composite Wood Council; (See CPA).
40. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
41. DHI - Door and Hardware Institute; www.dhi.org.
42. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
43. FM Approvals - FM Approvals LLC; www.fmglobal.com.
44. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
45. FSA - Fluid Sealing Association; www.fluidsealing.com.
46. FSC - Forest Stewardship Council U.S.; www.fscus.org.
47. GA - Gypsum Association; www.gypsum.org.
48. GANA - Glass Association of North America; www.glasswebsite.com.
49. GS - Green Seal; www.greenseal.org.
50. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
51. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
52. IAS - International Approval Services; (See CSA).
53. ICBO - International Conference of Building Officials; (See ICC).
54. ICC - International Code Council; www.iccsafe.org.
55. IEC - International Electrotechnical Commission; www.iec.ch.
56. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
57. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
58. IESNA - Illuminating Engineering Society of North America; (See IES).
59. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
60. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
61. ISO - International Organization for Standardization; www.iso.org.
62. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.

63. LMA - Laminating Materials Association; (See CPA).
64. LPI - Lightning Protection Institute; www.lightning.org.
65. MBMA - Metal Building Manufacturers Association; www.mbma.com.
66. MCA - Metal Construction Association; www.metalconstruction.org.
67. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
68. MMPA - Moulding & Millwork Producers Association; (Formerly: Wood Moulding & Millwork Producers Association); www.wmmpa.com.
69. MPI - Master Painters Institute; www.paintinfo.com.
70. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
71. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
72. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
73. NCMA - National Concrete Masonry Association; www.ncma.org.
74. NEBB - National Environmental Balancing Bureau; www.nebb.org.
75. NECA - National Electrical Contractors Association; www.necanet.org.
76. NEMA - National Electrical Manufacturers Association; www.nema.org.
77. NFPA - NFPA; (National Fire Protection Association); www.nfpa.org.
78. NFPA - NFPA International; (See NFPA).
79. NFRC - National Fenestration Rating Council; www.nfrc.org.
80. NHLA - National Hardwood Lumber Association; www.nhla.com.
81. NLGA - National Lumber Grades Authority; www.nlga.org.
82. NRCA - National Roofing Contractors Association; www.nrca.net.
83. NSPE - National Society of Professional Engineers; www.nspe.org.
84. PCI - Precast/Pre-stressed Concrete Institute; www.pci.org.
85. RFCI - Resilient Floor Covering Institute; www.rfci.com.
86. SDI - Steel Door Institute; www.steeldoors.org.
87. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
88. SJI - Steel Joist Institute; www.steeljoist.org.
89. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
90. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
91. SPRI - Single Ply Roofing Industry; www.spri.org.
92. SRCC - Solar Rating and Certification Corporation; www.solar-rating.org.
93. SSINA - Specialty Steel Industry of North America; www.ssina.com.
94. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
95. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
96. TCNA - Tile Council of North America, Inc.; (Formerly: Tile Council of America); www.tileusa.com.
97. TPI - Truss Plate Institute; www.tpinst.org.
98. UBC - Uniform Building Code; (See ICC).
99. UL - Underwriters Laboratories Inc.; www.ul.com.
100. USGBC - U.S. Green Building Council; www.usgbc.org.
101. WASTEC - Waste Equipment Technology Association; www.wastec.org.
102. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
103. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
104. WDMA - Window & Door Manufacturers Association; www.wdma.com.

105. WI - Woodwork Institute; (Formerly: WIC - Woodwork Institute of California); www.wicnet.org.
 106. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
 107. WPA - Western Wood Products Association; www.wwpa.org.
- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 2. ICBO - International Conference of Building Officials (See ICC)
 3. ICBO ES - ICBO Evaluation Service, Inc. (See ICC-ES)
 4. ICC - International Code Council; www.iccsafe.org.
 5. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up-to-date as of the date of the Contract Documents.
1. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 2. DOE - Department of Energy; www.energy.gov.
 3. EPA - Environmental Protection Agency; www.epa.gov.
 4. FG - Federal Government Publications; www.gpo.gov.
 5. GSA - General Services Administration; www.gsa.gov.
 6. HUD - Department of Housing and Urban Development; www.hud.gov.
 7. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 8. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 9. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 10. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 11. USPS - United States Postal Service; www.usps.com.
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. FED-STD - Federal Standard; (See FS).
 3. USAB - United States Access Board; www.access-board.gov.
 4. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

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

1. Washington State Department of Labor and Industries (L& I)

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for work.

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, Architect, 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 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 QUALITY ASSURANCE

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

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

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized steel, chain link fencing; minimum 6 feet high with galvanized steel pipe posts. Provide concrete bases for supporting posts. If portable fencing is desired as part of contractor's means and methods, review locations of proposed fencing with owner for approval prior to installation.
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- C. Temporary Partitions: wood 2x4s and plywood or particle board to separate area of work from publicly occupied library spaces. Temporary Partitions to be at minimum, 8'-0" tall. Fully secured dust protection to extend from 8' to underside of ceiling or structure to fully isolate work area. See plans for locations; review any proposed deviation of temporary partitions with owner and architect prior to start of work. Access to elevator and all required exits from public spaces must be maintained at all times during operating hours.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Contractor to set up a temporary job site office on the lower level of the Project site. No external office will be necessary.
- B. Common-Use Field Office: Owner, Architect, Contractor meetings to occur in the meeting space on the upper floor of the Project site. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Drinking water and private toilet.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 1. Locate facilities to limit site disturbance as specified in 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.

3.2 TEMPORARY UTILITY INSTALLATION

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

- F. 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.
- G. 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.
- H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Connect temporary service to Owner's existing power source, as directed by Owner.
- J. 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.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
- C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Review any required project identification signs and proposed locations with owner prior to installation.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 2. Maintain and touchup signs so they are legible at all times.
- E. 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."
- F. 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.
- G. 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.
- H. 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.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- 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. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- F. Security Enclosure and Lockup: Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

- H. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking anywhere on project site.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 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.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.

6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

PART 1 - GENERAL

1.1 SUMMARY

A . Section Includes:

1. Description of an Indoor Air Quality (IAQ) Construction Plan
2. IAQ Construction Requirements

B . Related Sections: Site protection specifications included in this section should be coordinated with the following sections of the Project Manual, including:

1. Section 01 74 21 – Construction Waste Management and Disposal
2. Division 6 Woodwork
3. Division 9 Finishes
4. Division 23 HVAC

1.2 SUBMITTALS

A . Indoor Air Quality Plan: Within fourteen (14) days after receipt of Notice of Award and prior to any waste removal by the Contractor from the Project, the Contractor shall develop and submit to the Owner for review a plan for mitigating hazardous air quality conditions that may arise from work operations during the project. The plan shall follow the recommended design approaches of SMACNA IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 Chapter 3 and shall include the following:

1. Protection of stored on-site and installed absorptive materials from moisture
2. Protection of ventilation system and permanently installed air handlers
3. Source control of construction contaminants, including sawdust, drywall dust, ventilation of paint operations
4. Pathway interruption
5. Housekeeping
6. Scheduling of work to minimize contamination
7. Schedule for inspection and maintenance of IAQ measures
8. Prohibit the use of tobacco products inside the building and within 25 feet of the building entrance during construction.

B . Product Data: Include product data for temporary filtration media (if used) and for filtration media used during occupancy.

C . Photographs: Provide photographs with date and time stamp taken at two different occasions during construction along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures.

1.3 SUBSTITUTIONS

A . Should the Contractor desire to use procedures, materials, equipment, or products that are not specified but meet the intent of these specifications to protect air quality on the site, the

Contractor shall propose these substitutions in accordance with Section 01 25 00 – Product Substitutions.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

3.1 ALL PHASES

- A . The Contractor is minimally required to meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition 2007 to:
1. Protect the ventilation system components from contamination, and/or provide cleaning of the ventilation components exposed to contamination during construction prior to occupancy.
- B . During installation of carpet, paints, furnishings, and other VOC-emitting products, provide supplemental (spot) ventilation for at least 72 hours after work is completed. Preferred HVAC system operation uses supply air fans and ducts only; exhaust provided through building openings. Use exhaust fans to pull exhaust air from deep interior locations. Stair towers and other paths to exterior can be useful during this process.
- C . Conduct regular inspection and maintenance of indoor air quality measures including ventilation system protection, and ventilation rate.
- D . Require VOC-safe masks for workers installing VOC-emitting products (interior and exterior) defined as products that emit 150 g/l or more UNLESS local jurisdiction's requirements (Canadian or US) are stricter, in which case the strictest requirement shall be followed for use of VOC-safe masks.
- E . Use low-toxic cleaning supplies for surfaces, equipment, and worker's personal use.
- F . Use wet sanding for gypsum board assemblies. Exception: Dry sanding allowed subject to owner approval of the following measures:
1. Full isolation of space under finishing
 2. Plastic protection sheeting is installed to provide air sealing during the sanding
 3. Closure of all air system devices and ductwork
 4. Sequencing of construction precludes the possibility of contamination of other spaces with gypsum dust
 5. Worker protection is provided
- G . Use safety meetings, signage, and subcontractor agreements to communicate the goals of the indoor air quality construction plan.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 23 00 "Alternates" for products selected under an alternate.
 - 2. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
 - 3. 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 specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 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. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.

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 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

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

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written 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."

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.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not 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.
 - 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 not 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.
- 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match 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.

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.

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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for limits on use of Project site.
 - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
 - 3. 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.

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. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. 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. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework,

investigate and verify the existence and location of underground utilities, electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

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 CONSTRUCTION LAYOUT

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

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 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 in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

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

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage.
- B. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."
- C. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

- D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
- F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

- A. 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.
 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.

3.8 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."

3.9 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 01 73 00

PART 1 - GENERAL 1.1 SUMMARY

- A. Section Includes:
 - 1. Construction waste management requirements by the City of Wenatchee.
 - 2. Waste Management Requirements
 - 3. Identification of items identified for reuse
 - 4. Deconstruction and Salvage Assessment requirements.
- B. Related Sections:
 - 1. 015000 – Temporary Facilities and Controls.
- C. This Section applies to all Technical Specification Sections, and supplements the General and Supplementary Conditions.

1.2 REFERENCES

- A. Sustainable Material Management Plan
- B. Waste Diversion Report.

1.3 DEFINITIONS

- A. Commingled or Off-site Separation: Collecting all material types into a single bin or mixed collection system and separating the waste materials into recyclable material types in an off-site facility.
- B. Construction, Demolition and Land Clearing Waste (CDL): For purpose of this section, includes all non-hazardous solid wastes such as building materials, packaging, rubbish, debris and rubble resulting from construction, remodeling, alterations, repair, deconstruction, demolition and land clearing.
- C. Deconstruction; The process of removing existing building materials from renovation and demolition projects for the purposes of reuse, and recycling, in as efficient and safe manner as possible. D. Hazardous Waste: As defined by the state where the Project is located.
- E. Recyclable Materials: Products and materials that can be recovered and remanufactured into new products.
- F. Recycling: The process of sorting, cleaning, treating and reconstituting materials for the purpose of using the material in the manufacture of a new product. Can be conducted on site (as in the grinding of concrete for reuse on site).
- G. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of a new product. Recycling facilities have their own specifications for accepting materials.
- H. Salvage and Reuse: Existing usable product or material that can be saved and reused in some manner on the project site. Materials that can be salvaged and reused on site must comply with the applicable technical specifications.
- I. Salvage for Resale: Existing usable product or material that can be saved and removed intact (as is) from the project site to another site for resale to others without remanufacturing.
- J. Source-Separated Materials: Materials that are sorted at the site for the purpose of reuse or recycling.
- K. Sources Separation: Sorting the recovered materials into specific material types with no or a minimum amount of contamination on site.
- L. Time-Based Separation: Collecting waste during each phase of construction or deconstruction that results in primarily one major type of recovered material. The material is removed before it becomes mixed with the material from the next phase of construction.
- M. Trash: Product or material unable to be salvaged for resale, salvaged and reused, returned, or recycled.

- N. Waste: Excess materials generated by the construction and demolition operations of the Project that are produced on site or brought to the site. Waste includes, without limitation, packaging materials such as banding, crates, pallets, plastic film, polystyrene, and cardboard. Waste does not include excavated soils, rocks, vegetation, and hazardous waste removed from the site

1.4 WASTE MANAGEMENT REQUIREMENTS

- A. Minimize the creation of construction and demolition waste on the job site. Minimize factors that contribute to waste, such as excess packaging, improper storage, ordering errors, poor planning, breakage, mishandling, and unnecessary contamination.
- B. Targeted Salvage Materials: The following existing materials shall be reused in the Project:
1. Existing LED light fixtures
 2. Existing ACT grid and tiles
- C. The following waste materials may be diverted from landfill to the greatest extent possible to meet the specified requirements:
1. Clean dimensional wood, pallet wood, plywood, OSB, and particleboard
 2. Asphalt.
 3. Concrete
 4. Concrete masonry units
 5. Brick
 6. Rock and gravel
 7. Soil and sand
 8. Ferrous and non-ferrous metals
 9. Gypsum products.
 10. Acoustical ceiling tile.
 11. Glass, both window and bottle.
 12. Plastics, including plastic film.
 13. Carpet and pad.
 14. Cardboard, paper, paper-based packaging
 15. Insulation
 16. Batteries.
 17. Doors, windows frames, relites, hardware, millwork.
 18. Other wood
 19. Equipment and appliances.
 20. Non-asbestos roofing.
- D. Hazardous materials such as paints, solvents, adhesives, batteries, and fluorescent light bulbs and ballasts which cannot be reused shall be disposed of at authorized hazardous waste outlets.

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable requirements of the jurisdictional authorities, local ordinances and regulations concerning management of construction waste, clearing, and inert materials.
- B. Preconstruction Meeting:
1. Prior to beginning work at the site, schedule and conduct a meeting to discuss procedures, schedules, coordination and specific requirements for waste materials recycling and disposal.
 2. Discuss coordination and interface between Contractor, sub-contractors, architect, engineers, project manager, Owner, and other C&D activities. Identify and resolve problems of compliance with requirements. Record minutes of the meeting, identifying conclusions reached and matters requiring further resolution. Maintain waste management as an agenda item at future construction meetings.
 3. Attendees: Contractor and related contractor personnel associated with work of this section, including personnel in charge of the waste management program; C&D Quality Manager;

architect; engineers; material and equipment suppliers where appropriate; and such additional Owner personnel as Owner deems appropriate.

- C. Disposal Site, Recyclers and Waste Materials Processors: Use only facilities properly permitted in the State where the Project is located, and/or by local authorities where applicable.

PART 2 - PRODUCTS 2.1 WASTE CONTAINERS

- A. Durable, covered, secured, reusable container for each category or waste.
- B. All recycling containers shall be clearly marked and shall list the materials which can be recycled as well as appropriate materials which cannot.

PART 3 - EXECUTION 3.1 PROJECT / SITE CONDITIONS

- A. Use construction methods that reduce construction waste. When possible:
 - 1. Order materials precut to required size.
 - 2. Order exact quantity required.
 - 3. Use temporary materials and facilities that will be reused at other projects.
- B. Field Measurements: Contractor is to verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders or proceeding with work, in order to minimize waste due to excessive materials.
- C. Protect products from damage during storage, installation and in-place. Materials that become wet, damp or unusable for any reason due to improper storage shall be replaced at the Contractor's expense.
- D. Request or require products delivered to the Site with packing materials that can be returned to sender, reused by others, or easily recycled.
- E. Use detailed take-offs to identify location and uses in structure to reduce risk of unplanned and potentially wasteful cuts.

3.2 PACKING AND SHIPPING

- A. Shipping: Coordinate the schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Packing: Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.3 CUTTING AND PATCHING

- A. Use on-site waste as primers, sealers, underlayments, supports, backing, blocking, furring, suspension systems, and accessories as required for any purpose in patching existing work.
- B. Provide environmentally benign non-hazardous or recycled content materials for cutting and patching.

END OF SECTION

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for 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.
- B. Related Requirements:
 - 1. Section 01 73 00 "Execution" for progress cleaning of Project site.
 - 2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 4. Section 01 79 00 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, 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.
 - 5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
 - 6. Advise Owner of changeover in heat and other utilities.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.

8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. 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.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment 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.
- 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.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in one of the following formats:
 - a. Built-in tracking log through project management software specifically intended for this purpose.
 - b. MS Excel electronic file. Architect will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where 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. 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.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Final cleaning to be by Owner. Waste-removal operations, by Contractor, to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. 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 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.

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA PART

1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Operation manuals for systems, subsystems, and equipment.
 - 3. Product maintenance manuals.
 - 4. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. 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 10 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.

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.

2.2 REQUIREMENTS FOR 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 Architect.
 - 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents by CSI divisions. If possible, assemble instructions for subsystems, equipment, and components of one system into a single file.
- 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 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.

2.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance

service contracts, and warranty and bond information, as described below.

- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Section 01 78 39 "Project Record Documents."
- F. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 01 73 00 "Execution" for final property survey.
 - 2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

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

- B. Record Specifications: Submit one annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal as part of operation and maintenance data.

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. Locations of concealed internal utilities.
 - i. Changes made by Change Order or Construction Change Directive.
 - j. Changes made following Architect's written orders.
 - k. Details not on the original Contract Drawings.
 - l. Field records for variable and concealed conditions.
 - m. 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 with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 01 33 00 "Submittal Procedures" for requirements related to use of Architect's digital data files.

2.2 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 and record Drawings where applicable.
- B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

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 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.
- B. Unit Price for Instruction Time: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up. See requirements in Section 01 22 00 "Unit Prices."

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For instructor.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit one electronic copy within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name of Architect.
 - c. Name of Contractor.
 - d. Date of video recording.

2. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals and in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 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 operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 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. Operations manuals.
 - b. Maintenance manuals.
 - c. Project record documents.
 - d. Identification systems.
 - e. Warranties and bonds.
 - f. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.

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

PART 3 - EXECUTION

3.1 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.

3.2 INSTRUCTION

- A. 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.
- B. 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 seven days' advance notice.
- C. 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.

- D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 79 00

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Delegated design of components or supports requiring structural engineering before, during, or after demolition; or any engineering for cutting into structural assemblies.
- B. Selective demolition of building elements.
- C. Utility Services and Mechanical/Electrical System.
- D. Salvaged and removal of building elements.

1.2 RELATED REQUIREMENTS

- A. 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 30 00 - Administrative Requirements.
- 1. Review preparation and installation procedures and coordinating and scheduling required with related work.
- 2. Review Owner salvage requirements and conduct a walk-through with Owner present.

1.4 SUBMITTALS

- A. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of partitions, barricades and fences.
 - 2. Include procedures and coordination with other work in progress, a disconnection schedule of utility services, and a detailed description of methods and equipment to be used for each operation and of the sequence of operations.
 - 3. Identify demolition firm and submit qualifications.
 - 4. Include a summary of safety procedures.
- D. Engineering Survey.

- E. Existing Condition Survey.
- F. Shop Drawings: extents of demolition, locations of existing utilities, and locations of utility capping. Indicate structural members and elements that will be demolished. .
- G. Closeout Submittals: Accurately record actual locations of capped and active utilities and subsurface construction.

1.5 QUALITY ASSURANCE

- A. Demolition Contractor Qualifications: Company specializing in selective demolition comparable in scope, environmental and historical sensitivity of work specified in this section with minimum 5 years experience.
- B. Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Selectively demolish existing elements to accommodate tie-in of new work to existing conditions.
- B. Existing building hazardous material and asbestos surveys has been completed by Owner, and survey is included in the Appendix. Contractor is responsible for the legal abatement and disposal of all elements as required to complete contract work.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A. 29 CFR 1910: Occupational Safety and Health Standards.
- B. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- C. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.
- D. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
- G. Comply with governing EPA notification regulations before beginning selective demolition.
- H. Comply with hauling and disposal regulations of authorities having jurisdiction.

2.3 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before start of work.
- B. Review record documents provided by Owner and schedule listing salvage and remove for reuse items.
- C. Engage a professional engineer to perform an engineering survey to determine if removing indicated elements may result in a structural deficiency or unsafe condition during scope of work.
- D. Perform a survey of existing conditions by use of measured drawings and preconstruction photographs.
- E. A hazardous materials report has been completed by the Owner and is included as an Appendix. Contractor is required to legally remove and dispose of materials as required to complete work.
 - 1. If suspected hazardous materials are encountered, beyond those described in the report, do not disturb; immediately notify Architect and Owner.

3.2 PREPARATION

- A. 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.
- B. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

3.3 SELECTIVE DEMOLITION OF BUILDING ELEMENTS

- A. 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.
- B. 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.
- 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 reinstalled in their original locations after selective demolition operations are complete.

- D. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

3.4 SALVAGE AND REMOVAL OF BUILDING ELEMENTS

A. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- C. 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 flamecutting operations.

- D. Maintain fire watch during and for at least two hours after flame-cutting operations.

- E. Dispose of demolished items and materials promptly.

3.5 CLEANING

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

- B. 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.

C. Dispose of all waste material in accordance with project's Waste Management Plan.

1. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.6 PROTECTION

A. Remove temporary barricades and protections where hazards no longer exist.

3.7 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. 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. If services/systems are required to be removed, relocated or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove 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. Equipment to be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

3.8 SCHEDULE

A. Locations and extent in accordance with demolition drawings, including but not limited to:

1. Selective demolition of portions of exterior walls at locations of new openings
2. Selective Demolition of existing nonbearing walls and lower level
3. Selective Demolition of toilet rooms and plumbing fixtures as described
4. Selective Demolition to allow new work of routing plumbing, structure, and HVAC
5. Removal of finishes as described. Note removal and salvage of areas of ACT ceiling and light fixtures for reuse within project.

B. Delegated Design Items: See Section 01 11 50 Delegated Design and Deferred Submittals.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Fire-retardant-treated wood materials,
- B . Preservative treated wood materials,
- C . Miscellaneous wood nailers, furring, and grounds.

1.2 RELATED REQUIREMENTS

- A . 013000 – Administrative Requirements: For additional requirements of preinstallation meeting.
- B . 016000 – Product Requirements: For substitution and additional product requirements.
- C . 017419 – Construction Waste Management and Dispose: Limitations on disposal of removed materials; requirements for recycling.

1.3 DEFINITIONS

- A . Fire-Retardant-Treated Wood: Wood products that, when impregnated with chemicals by a pressure process or other means during manufacture, exhibit reduced surface-burning characteristics and resist propagation of fire.
 - 1. When tested in accordance with ASTM E84 or UL 723, a listed flame spread index of 25 or less and show no evidence of significant progressive combustion when the test is continued for an additional 20-minute period. Additionally, the flame front shall not progress more than 10-1/2 feet beyond the centerline of the burners at any time during the test.
- B . Preservative-treated wood: Wood products that, conditioned with chemicals by a pressure process or other means, exhibit reduced susceptibility to damage by fungi, insects or marine borers.

1.4 ADMINISTRATIVE REQUIREMENTS

- A . Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 013000 - Administrative Requirements.

1.5 SUBMITTALS

- A . Qualification Data: For fabricator.
- B . Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.
- C . Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- D . Accessory Material VOC Content Certification

1.6 QUALITY ASSURANCE

- A . Manufacturer Qualification: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.
- B . Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.7 DELIVERY, STORAGE, AND HANDLING

- A . Fire-Retardant-Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A . General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B . Preservative Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Provide miscellaneous rough carpentry items including fire retardant treated wood materials, preservative treated wood materials, miscellaneous wood nailers, furring, and grounds.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A . Provide Preservative-Treated Wood in locations required by ICC (IBC)-2018, Section 2304.12.1 through 2304.12.7, "Locations requiring water-borne preservatives or naturally durable wood," complying with the following requirements:
 - 1. Comply with American Wood Protection Association AWP A U1 and AWP A M4.
 - 2. Identification of Preservative-Treated Wood:
 - a. Provide all preservative-treated wood, identified in accordance with ICC (IBC)-2018, Section 2303.1.9.1, to include: identification of the treating manufacturer; type of preservative used; minimum preservative retention (pcf); end use for which the product is treated; AWP A standard to which the product was treated; identity of the accredited inspection agency.
 - 3. Moisture Content of Preservative-Treated Wood:
 - a. Where preservative-treated wood is used in enclosed locations where drying in service cannot readily occur, such wood shall be at a moisture content of 19 percent or less before being covered with insulation, interior wall finish, floor covering or other materials; in accordance with ICC (IBC)-2018, Section 2302.1.9.2.
 - 4. Fastener requirements at Preservative-Treated Wood:
 - a. Fasteners and connectors in contact with preservative-treated wood and fireretardant-treated wood, in accordance with ICC (IBC)-2018, Section 2304.10.5; ASTM A153/A153M, ASTM F1667.

- 1) Fasteners or connectors for preservative-treated wood, including exceptions, in accordance with ICC (IBC)-2018, Section 2304.10.5.1.

B. Provide Fire-Retardant-Treated (FRT) Wood in accordance with the following requirements:

1. Fire-retardant-treated wood to be manufactured, tested, and labeled in accordance with ICC (IBC)-2018, Section 2303.2.
2. Labeling of FRT Wood:
 - a. Provide all FRT wood, labeled in accordance with ICC (IBC)-2018, Section 2303.2.4, to include: identification mark of an approved agency in accordance with Section 1703.5; identification of the treating manufacturer; name of the fire retardant treatment; species of wood treated; flame spread and smoke-developed index; method of drying after treatment; and conformance with appropriate standards in accordance with Sections 2303.2.5 through 2303.2.8.
 - 1) For FRT wood exposed to weather, damp or wet locations, include the words "No increase in the listed classification when subjected to the Standard Rain Test" as required by ASTM D2898 and identified as "Exterior," in accordance with ICC (IBC)-2018, Section 2303.2.4.
 - 2) Provide FRT sawn lumber, identified in accordance with sawn lumber labeling requirements of ICC (IBC)-2018, Section 2303.1.1.
 - 3) Provide FRT wood structural panels, identified in accordance with wood structural panel labeling requirements of ICC (IBC)-2018, Section 2303.1.5.
3. Moisture Content
 - a. Interior FRT wood shall be dried to a moisture content of 28 percent or less in accordance with ASTM D3201/D3201M procedures at 92 percent relative humidity, in accordance with ICC (IBC)-2018, Section 2303.2.7.
 - b. FRT wood shall be dried to a moisture content of 19 percent or less for lumber and 15 percent or less for wood structural panels before use, in accordance with ICC (IBC)-2018, Section 2303.2.8.
4. Flame Spread Rating:
 - a. In order for FRT wood to be substituted for non-combustible materials, it must have a Class A rating.
 - b. Classified as Class A or I : Flame spread Index 25 or less when tested in accordance with ASTM E84 or UL 723.
5. Required strength adjustment modifications to engineering calculations due to design values for FRT wood to be modified in accordance with ICC (IBC)-2018, Section 2303.2.5; ASTM D5516, ASTM D5664, ASTM D6305, and ASTM D6841.
 - a. In-field modifications outside of standard sawing and fastening may modify the burning characteristics of the products.
6. Fastener requirements at FRT Wood:
 - a. Fasteners and connectors in contact with preservative-treated wood and fire-retardant-treated wood, in accordance with ICC (IBC)-2018, Section 2304.10.5; ASTM A153/ A153M, ASTM F1667.
 - 1) Fasteners for fire-retardant-treated wood used in exterior applications or wet or damp locations, in accordance with ICC (IBC)-2018, 2304.10.5.3.
 - 2) Fasteners for fire-retardant-treated wood used in interior applications in accordance with ICC (IBC)-2018, 2305.10.5.4.

2.3 MATERIALS

A . Lumber, General:

1. Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by the American Lumber Standards Committee's (ALSC) Board of Review. Provide dressed lumber, S4S, with each piece factory marked with grade stamp of inspection agency.

B . Wood-Preservative-Treated Materials:

1. Comply with applicable requirements of AWPAC C2 (lumber) and AWPAC C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review. Dimension Lumber: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated. Refer to Structural "General Notes" located in the Drawings.

C . Fire-retardant-Treated Materials:

1. Basis of Design Products:
 - a. Exterior Fireproofing: Hoover Treated Products "Exterior Fire-X."
 - b. Interior Fireproofing: Clear finish product, Lonza Wood Protection "Dricon," Hoover Treated Wood Products "Pyro-Guard," or Koppers Performance Chemicals, "FirePRO."
2. Classification: Class A.

D . Miscellaneous Lumber:

1. Provide No. 3 or Standard grade lumber of any species for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, and similar members.

2.4 ACCESSORIES

A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B . Fasteners and Anchors:

1. Metal and Finish: Stainless steel for exterior, high humidity or preservative-treated wood location, unfinished steel elsewhere.

C . Sill Flashing:

1. Sill Flashing: As specified in Section 076200 – Sheet Metal Flashing and Trim.

PART 3 - EXECUTION

3.1 EXAMINATION

A . Verify existing conditions meet the manufacturer's requirements before starting work.

B . Verify products have been stored, and will be installed, in accordance with project's Construction Indoor Air Quality Management Plan specified in Section 015721 - Indoor Air Quality Controls.

3.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION – GENERAL

- A . Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.4 FRAMING INSTALLATION

- A . Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.
- B . Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.

3.5 BLOCKING, NAILERS, AND SUPPORTS

- A . In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- B . In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C . In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D . Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.6 INSTALLATION OF CONSTRUCTION PANELS

- A . Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.
- B . Subflooring: Glue and nail to framing; staples are not permitted.
- C . Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
 - 1. At long edges provide solid edge blocking where joints occur between roof framing members.
- D . Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
 - 1. Use plywood or other acceptable structural panels at building corners, for not less than 96 inches, measured horizontally.
 - 2. Provide inlet diagonal bracing at corners.

3.7 TOLERANCES

- A . Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.8 CLEANING

- A . Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- B . Prevent sawdust and wood shavings from entering the storm drainage system.
- C . Waste Disposal: Comply with the requirements of Section 017419 - Construction Waste Management and Disposal.

3.9 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.10 SCHEDULE

- A . Preservative-treated wood materials:
 - 1. Any wood required to be treated by the local authority having jurisdiction.
 - 2. Classification and location as indicated.
 - 3. Preservative-treated products by location:
 - a. Wood framing members less than 8-inches above grade.
 - b. Wood contacting concrete and masonry, roofing membrane and elsewhere as indicated or required.
 - c. Wood floor plates that are installed over concrete slab-on-grade.
 - d. Plywood where indicated or required.
 - e. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, coping substrate and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
 - f. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.
 - g. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
- B . Fire-retardant-treated wood materials:
 - 1. Any wood required to be treated by the local authority holding jurisdiction.
 - 2. Classification and location as indicated.
 - 3. FRT products by location: any wood in fire rated walls and assemblies. Any exterior walls in type III-B construction including the modifications to exterior envelope for new windows.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Finish carpentry materials.

1.2 RELATED REQUIREMENTS

- A . 016000 – Product Requirements: For substitution and additional product requirements.
- B . 017419 – Construction Waste Management and Dispose: Limitations on disposal of removed materials; requirements for recycling.
- C . 061000 – Rough Carpentry: for additional carpentry items.
- D . 064100 – Architectural Wood Casework
- E . 099000 – Painting and Coating: for field finish of finish carpentry items.

1.3 SUBMITTALS

- A . Qualification Data: For fabricator.
- B . Product Data:
 - 1. Provide instructions for attachment hardware and finish hardware.
- C . Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Minimum Scale of Detail Drawings: 1-1/2 in to 1 foot.
 - 2. Provide the information required by AWI/ AWMAC/WA (AWS) Architectural Woodwork Standards.
- D . Sample: Submit three samples of each type of wood exposed to view, 11 inches by width of board (or 8 inches max) inch in size illustrating wood grain and specified finish.
- E . Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining systems's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE

- A . Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Single Source Responsibility: Provide and install this work from single fabricator.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . Fire-Retardant-Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A . As required by the Quality Certification Program for installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Wood frames, dimensional lumber and plywood, wall base, and other wood trim, moldings, bases, casings, and miscellaneous trim for doors, glazed lights, and window sills. Carpentry items shop fabricated and finished in accordance with AWI/AWMAC/WI (AWS) Architectural Wood Work standards.

2.2 PERFORMANCE AND DESIGN CRITERIA

A . FINISH CARPENTRY ITEMS

- 1. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) Architectural Woodwork Standards for Premium Grade.

2.3 MATERIALS

A . Interior Woodwork Items:

- 1. PTD Wood Base, Window and other Trims:
 - a. Species and Finish: Pre-primed finger-jointed paint grade wood trim.
 - b. Profiles: As indicated.
- 2. PLAM sills at new and select existing windows
 - a. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) Architectural Woodwork Standards for Custom grade.
 - b. Size and Profiles: As indicated in details.

B . Lumber Materials:

- 1. Softwood Lumber: fir species, quarter sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.

C . Sheet Materials:

- 1. Softwood Plywood Not Exposed to View: Any face species, veneer core; PS 1 Grade A-B; glue type as recommended for application.
- 2. Softwood Plywood Exposed to View: Face species as indicated, plain sawn, medium density fiberboard core; PS 1 Grade A-B; glue type as recommended for application.

D . Flame Retardant: WT-103 by FireTect. Finish: Clear Matte. Performance: Provides ASTM E84 Class B.

E . Shop Finishing:

- 1. Sand work smooth and set exposed nails and screws.
- 2. Apply wood filler in exposed nail and screw indentations.

3. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
4. Finish work in accordance with AWI/AWMAC/WI (AWS) Architectural Woodwork Standards, Section 5 - Finishing for Grade specified and as follows:
 - a. Transparent:
 - 1) Clear Varnish: Handrails and other high-touch locations; Red List free.
 - b. Opaque:
 - 1) Back prime woodwork items to be field finished, prior to installation.

F. Site Finishing:

1. In accordance with Section 099000 – Painting and Coating.

2.4 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions meet the requirements of the quality standard specified before starting work.
- B. Verify products have been stored, and will be installed, in accordance with project's Construction Indoor Air Quality Management Plan specified in Section 015721 - Indoor Air Quality Controls.

3.2 PREPARATION

- A. Prepare surfaces to receive work in accordance with quality standard specified.

3.3 INSTALLATION

- A. General: Install all materials in accordance with quality standard specified based on conditions present.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
1. Scribe and cut to fit adjoining work. Refinish and seal cuts as recommended by quality standard.
 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32 inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 4. Install stairs with no more than 3/16 inch variation between adjacent treads and risers and with no more than 3/8 inch variation between largest and smallest treads and risers within each flight.

- C . Install with trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

3.4 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 – Construction Waste Management and Disposal and project's Waste Management Plan.

3.5 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cabinetry.
- B. Cabinet Hardware.
- C. Countertops for cabinetwork.
- D. See Section 06 20 00 for PLAM windowsills

1.2 RELATED REQUIREMENTS

- A. 01 43 39 - Mockups: For additional requirements related to the mockups in this section.
- B. 01 60 00 - Product Requirements: For substitution and additional product requirements.
- C. 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- D. 06 10 00 - Rough Carpentry: For hidden shelf supports.
- E. 06 20 00 - Finish Carpentry: For additional wood-based products.
- F. 09 22 19 - Non-Structural Metal Framing: Support framing, grounds, and concealed blocking for metal stud construction.
- G. 09 90 00 - Painting and Coating: Site finishing of cabinet interior.

1.3 ADMINISTRATIVE REQUIREMENTS

1.4 SUBMITTALS

- A. Qualification Data: For fabricator and installer.
- B. Product Data: Provide data for hardware, accessories, and finishes.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS) Architectural Woodwork Standards.
 - 3. Provide schedule of drawer locations where soft-close drawer slide features are not available; Architect to review and revise style as required.

- D. Sample: Submit sample of cabinet panel construction, minimum 12 inches square, illustrating proposed cabinet substrate and finish.
- E. Hardware Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.
- F. Manufacturer's Installation Instructions: For finishes and hardware. Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- G. Maintenance Data: For user operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.5 MAINTENANCE MATERIAL

- A. Furnish extra materials described below, before installation begins, that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
 - 1. Cabinet and Drawers: Provide (4) sets of keys to Owner.

1.6 QUALITY ASSURANCE

- A. Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum of 5 years of experience.

1.7 MOCKUP

- A. Construct mockup of single base cabinet; minimum 9 inches wide, to include door representing laminate, wood grain direction, and matching of material, cabinet interior, fit, finish, matching edgebanding and selected hardware.
- B. Mockup may not remain as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. As required by the quality standard and fabricator for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Custom designed and fabricated casework and associated accessories and hardware.

2.2 SELECTED INDUSTRY GRADES

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) Architectural Woodwork Standards.
 - 1. Pattern matching for finishes based on selected grade and as indicated below:
 - a. Premium Grade:
 - 1) Doors, drawer fronts and false fronts and laminate pattern to run and match vertically within each cabinet unit.
 - 2) Soft close hinges, soft close doors.
 - 3) Public Areas Casework:
 - a) Finish: Wilsonart Traceless laminate, selections per finish schedule
 - b) Self-edge.
 - c) Thru-color.
 - b. Custom Grade:
 - 1) Soft close hinges, soft close doors
 - 2) Staff Kitchen:
 - d) Finish: Wilsonart Standard laminate, selections per finish schedule
 - e) Self-edge.

2.3 MATERIALS

- A. Cores:
 - 1. Per AWS Standards
- B. Countertop Edge Materials:
 - 1. Self Edged; no PVC or Vinyl trims permitted
- C. Plastic Laminate Materials:
 - 1. Basis of Design: Wilsonart Traceless where noted; Wilsonart Standard where noted.
 - a. Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 - Product Requirements.
 - 2. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
 - a. Horizontal Surfaces: HGS, 0.048 inch nominal thickness.

- b. Vertical Surfaces: VGS, 0.028 inch nominal thickness.
- c. Non-exposed substrate per casework manufacturer.
- d. Color: Architect to select from full range of manufacturer's colors.
- e. Flame Retardant Surfaces: HGF, 0.048 inch nominal thickness.
- f. Cabinet Liner: CLS, 0.020 inch nominal thickness.
- g. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.4 CABINET HARDWARE

A. Drawer Slides:

- 1. Basis of Design: Accuride International, Inc.
- 2. Performance Criteria:
 - a. Rated medium duty grade for drawer size indicated.
 - 1) Drawer slides rated for 100 lbs. minimum; soft-close feature available.
 - b. Rated extra heavy duty grade for drawer size indicated.
 - 1) Drawer slides rated for 250 lbs. minimum; soft-close feature not available.
- 3. Features:
 - a. Full extension.
 - b. Soft-close, stay-closed feature where indicated above. B.

Door and Drawer pulls:

- 2. Public Area Basis of Design: Hafele; Versa Collection.
 - a. Item #: 133.53.407.
- 3. Performance Criteria:
 - a. ADA Standards Compliant.
- 4. Features:
 - a. Style: Bar pulls.
 - b. Finish: Matt black.
 - c. Handles: Zinc.

- d. CTC: 160 mm.
- e. Locks: CAM locks; matte black; keyed.

C. Hinges: European-style, concealed, opening to 135 degrees; soft-closing.

2.5 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Particleboard for Countertop Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
 - 1. Made with binder containing no urea formaldehyde.
- C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- D. Joint Sealant: Mildew-resistant silicone sealant per Section 079005 Joint Sealers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A. Prepare surfaces to receive work in accordance with Quality Standards.

3.3 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B. Assemble cabinets and complete fabrication.
- C. Anchor cabinets to structure. Secure with countersunk, concealed fasteners
 - 1. For shop finished items, use color matched wood filler.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned.

3. Maintain veneer sequence matching of cabinets with transparent finish.

E. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.4 ADJUSTING

A. Adjust and lubricate hardware for proper operation. Adjust hardware to center doors and drawers in openings and to provide smooth operation. Complete installation of hardware and accessory items as indicated.

3.5 CLEANING

A. Dispose of all waste material in accordance with project's Waste Management Plan.

1. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.6 PROTECTION

A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Acoustic Batt Insulation.
- B . Foam Detailing Insulation.

1.2 RELATED REQUIREMENTS

- A . 016000 – Product Requirements: For substitution and additional product requirements.
- B . 017419 – Construction Waste Management and Disposal: Limitations on disposal of removed material; requirements for recycling.
- C . 092116 – Gypsum Board Assemblies: For acoustic insulation installed as a component of assemblies

1.3 SUBMITTALS

- A . Qualification Data: For installer, manufacturer, and design engineer.
- B . Product Data: Provide data on product characteristics, performance criteria, and product limitations and product schedule indicating where each material will be used.
- C . Test Report: Submit report of full-size mockup test for NFPA 285 fire performance, with project cladding assemblies highlighted, for foam insulation on exterior.
- D . Shop Drawings: Indicate required flashings, control joints, and expansion joints, and sealing details at openings, projections, penetrations, and sleeves to maintain continuous thermal barrier.
- E . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
 - 1. Include recommended fastening components and spacing to control sag.
 - 2. Include manufacturer's recommended product for thermal barrier over foam insulation exposed to interior in accordance with IBC 2012.2603.4.
 - a. ". . .tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275."

1.4 QUALITY ASSURANCE

- A . Manufacturer Qualification:
- B . Designer Qualifications:
- C . Installer Qualifications: company specializing in performing the work of this section with minimum 2 years of experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . As required by the Quality Certification Program for installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A . Fiber batt, and low expansion detailing foam thermal insulation

2.2 MATERIALS

A . Fiber Batt Insulation:

1. Mineral Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - a. Substitutions for products by manufacturers other than those listed above: See Section 016000 - Product Requirements.
 - b. Performance Criteria:
 - 1) Combustibility: Non-combustible, when tested in accordance with ASTM E136.
 - 2) Manufactured with binder containing no added urea formaldehyde.
 - 3) Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
 - 4) Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 5) Thermal Resistance (R Value) at 40 degrees F/inch of thickness: 3.1.
 - c. Features:
 - 1) Formaldehyde Free.

B . Low Expansion detailing foam insulation

1. For infill where exterior wall insulation is removed to achieve work. Assure product is compatible with existing exterior insulation.

2.3 ACCESSORIES

A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B . Protection Membrane: White, Polypropylene fiberglass scrim.

1. Basis of Design Product: WMP-10 by LAMTEC Corporation.
2. Performance:
 - a. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
 - b. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - c. Light Reflectance: 85% minimum when tested in accordance with ASTM C423.
 - d. Tensile Strength: 40 lbs/inch width (MD) when tested in accordance with ASTM C1136.
 - e. Dimensional Stability: 0.030% maximum when tested in accordance with ASTM D1204.

- C . Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Verify existing conditions meet the manufacturer's requirements before starting work.
- B . Verify products have been stored, and will be installed, in accordance with project's Construction Indoor Air Quality Management Plan specified in Section 015721 - Indoor Air Quality Controls.

3.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A . General: Install all materials in accordance with quality standard specified based on conditions present.

3.4 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 – Construction Waste Management and Disposal and project's Waste Management Plan.

3.5 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.6 SCHEDULE

- A . Fiberglass Batt Insulation
 - 1. Manufacturer: Owens Corning or approved equal.
 - 2. Application: Unfaced batts for loose-laid installation above ceilings. Friction fit batts in interior walls for STC ratings
- B . Foam Detailing Insulation
 - 1. Application: as required to infill where exterior walls are modified.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Liquid Applied Weather Barrier Coating.
- B. Flexible Flashings.

1.2 RELATED REQUIREMENTS

- A. 01 60 00 - Product Requirements: For substitution and additional product requirements.
- B. 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C. 07 21 00 - Thermal Insulation: Vapor retarder and air barrier components installed in conjunction with insulation.
- D. 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

1.3 DEFINITIONS

- A. Weather Barrier: Assemblies that form water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
- C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
- D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture-resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.4 ADMINISTRATIVE REQUIREMENTS

1.5 SUBMITTALS

- A. Qualification Data: For manufacturer and installer.
- B. Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.
- C. Shop Drawings: Indicate extents, special joint or termination conditions, and conditions of interface with other materials. Indicate line of continuous air barrier at building exterior.
- D. Manufacturer's Field Service Reports: Provide site reports from authorized field service representative, indicating observation of air barrier system installation.

- E. Test Report: Submit report of full-size mockup test for NFPA 285 fire performance.
- F. Field test results.
- G. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, perimeter conditions requiring special attention, and storage and handling criteria.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience with local product representation available to review product installation.
- B. Installer Qualifications: Company specializing in performing the work of this section, using specified materials with minimum 5 years of experience on projects of similar size and complexity.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.8 WARRANTY

- A. Manufacturer's warranty for air barrier for a period of ten (10) years from date of Purchase.
 - 1. Preinstallation meeting and jobsite observations by air barrier manufacturer may be required for specified warranty.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Components of liquid-applied weather barrier system and all associated liquid applied flashings.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A. Air Permeability:
 - 1. The system: Air permeability not to exceed 0.04 cfm/ft² under a pressure differential listed, when tested per ASTM E2357
- B. Air Infiltration: 0.004 cfm/sq ft maximum per ASTM E283.
- C. Fire Performance: Tested in accordance with, and complying with the acceptance criteria of, NFPA 285; testing must be performed specifically for this project.

- D. Fire Performance: Combustible exterior wall coverings shall be tested in accordance with NFPA 268.

- 1. Code Reference: SBC 2018.1405.1.1.

2.3 MATERIALS

A. Liquid Applied Weather Barrier Coating:

- 1. Basis of Design: Cat-5 Rainscreen by Prosoco
- 2. Performance Criteria:
 - a. Air Permeance: Pass: 0.004 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
 - b. Water Vapor Permeance: 15 perms, minimum, when tested in accordance with ASTM E96/E96M.
- 3. Features:
 - a. Material Thickness: 12-15 mils as recommended by manufacturer to attain the performance criteria specified over the substrates present.
 - b. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for ultraviolet and weather exposure.
 - c. Color: To be selected by Architect from manufacturer's full range.
- 4. Location: Rainscreen wall assemblies.

B. Flexible Flashings.

- 1. Liquid Flashing Membrane: Product recommended by weather barrier manufacturer to maintain performance criteria while transitioning to rough openings.
- 2. Basis of Design: R-Guard Fast Flash by Prosoco.
- 3. Location: Concealed flashing.
- 4. Self-Adhering Flexible Flashing: SBS-modified bituminous sheet membrane, 30 mil minimum thickness, laminated to a cross-laminated polyethylene film, in factory cut widths.
 - a. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Flashing product recommended by weather barrier manufacturer.
 - 2) Transition and termination where sheet membrane is challenging or 8-inch upturn height cannot be achieved: Siplast parapro 123.

5. Primers, Cleaners, Insulation Adhesive, Joint Compound, and Sealant Materials: As recommended by air barrier manufacturer, appropriate to application, and compatible with adjacent materials.

2.4 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Liquid Flashing Membrane:
 1. At locations recommended by air and water-resistant membrane manufacturer.
- C. Primer:
 1. Liquid waterborne or solvent-borne primer recommended for substrate by air and water barrier material manufacturer.
- D. Joint Reinforcing Strip:
 1. Manufacturer's joint reinforcing tape.
- E. Substrate-Patching Membrane:
 1. Manufacturer's standard trowel-grade substrate filler.
- F. Adhesive and Tape:
 1. Manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- G. Metal Flashings:
 1. Per 07 62 00 - Sheet Metal Flashing and Trim.
- H. Joint Sealant:
 1. Per 07 90 05 - Joint Sealers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

- B. Follow specific requirements for lapping and integration with flashings described in the details to form an air and weather tight installation.
- C. Where primer is required, primer substrates at a rate required by air and water barrier manufacturer and allow it to dry. Limit priming to areas that will be covered by material on same day. Re-prime areas exposed for more than 24 hours.
 - 1. Where required, prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- D. Connect and seal exterior wall air and water barrier material continuously to the following areas where applicable, using accessory materials as indicated in the Drawings:
 - 1. Roofing-membrane, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings.
- E. Install air and water barrier as recommended by the manufacturer around window and door rough openings and at penetrations after sheathing is installed and penetrations have been secured. Provide minimum overlaps as require.
- F. Coordinate installations with Section 07 62 00 - Sheet Metal Flashing and Trim to provide air tight transitions within the air and weather barrier membrane including but not limited to rough opening and penetration heads, ledger angles, and cross cavity through wall flashings. Install tapes and sealant continuously as required to provide an air tight installation.
- G. Secure and/or adhere the air and weather barrier system as required by manufacturer.
- H. Ensure that air and weather barrier is air tight, free from holes, gouges, and punctures.
- I. Cover air and weather barrier system within manufacturer's recommended exposure timeframe.

3.4 CLEANING

- A. Clean dust, dirt, and debris from the surface of air and water-resistant barriers prior to installation of furring and/or cladding materials.
- B. Dispose of all waste material in accordance with project's Waste Management Plan.
 - 1. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.5 PROTECTION

- A. Protect air and water barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 - 1. Protect air and weather barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for longer than manufacturer's recommended timeframe, remove and replace fluid-applied air and

weather barrier or install additional, full-thickness, fluid-applied air and weather barrier application after repairing and preparing the overexposed membrane according to fluid applied air and weather barrier manufacturer's written instructions.

2. Protect fluid-applied air and weather barrier from contact with incompatible materials and sealants not approved by fluid-applied air and weather barrier manufacturer. B.
Repair damage before proceeding with subsequent construction.
- C. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- D. Remove masking materials after installation.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Fabricated sheet metal items.

1.2 RELATED REQUIREMENTS

- A . 013000 – Administrative Requirements: For additional requirements of preinstallation meeting.
- B . 016000 – Product Requirements: For substitution and additional product requirements.
- C . 017419 – Construction Waste Management and Disposal: Limitations on disposal of removed material; requirements for recycling.
- D . 072500 – Weather Barriers: Moisture protection and underlayments under sheet metal flashings.
- E . 079005 – Joint Sealers: Sealants installed with sheet metal flashing and trim.

1.3 ADMINISTRATIVE REQUIREMENTS

- A . Preinstallation Meeting: Convene one month before starting work of this section in accordance with Section 013000 - Administrative Requirements.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 SUBMITTALS

- A . Qualification Data: For fabricator.
- B . Shop Drawings: Indicate material profile, jointing locations, jointing details, fastening methods, flashings, terminations, and installation details. Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop and field assembled work. Include the following:
 - 1. Identify material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim,
- C . Samples:
 - 1. Finish Sample: Submit two samples illustrating each metal finish color.
 - 2. Fabrication Sample: Submit sample of coping lap joint as it will occur every 10 feet.
- D . Warranty: Submit manufacturer finish warranty and ensure forms have been completed in

1.5 QUALITY ASSURANCE

- A . Fabricators Qualification: Company specializing in the manufacture of work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.6 DELIVERY, STORAGE, AND HANDLING

- A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.7 WARRANTY

- A . Manufacturer's Finish Warranty: Correct defective work within a 20 year period after Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
 - 1. Panel Finish Criteria are listed AAMA 2605.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Sheet metal including steel, stainless steel, and aluminum fabricated into items such as flashings, counterflashings, gutters, downspouts, and other items indicated and scheduled.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A . General: Install sheet metal flashing and coping to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B . Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
 - 1. Temperature Change (Range): 120 deg, ambient; material surfaces.

2.3 MATERIALS

- A . Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch thick base metal.
- B . Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch thick base metal, shop pre-coated with PVDF coating.
- C . Pre-Finished Aluminum: ASTM B209; 0.032 inch thick; plain finish shop pre-coated with fluoropolymer coating.
- D . Stainless Steel: for masonry use: ASTM A666 Type 304, soft temper, 0.018 inch thick; smooth mill finish.
- E . Stainless Steel: For all other uses: ASTM A666 Type 304, rollable temper, 0.018 inch thick; smooth No. 4 finish.

2.4 FABRICATION

- A . Conform to referenced SMACNA manual, Manufacturer's recommendations if premanufactured and as detailed. Conform to following general requirements:
- B . Form sections true to shape, accurate in size, square, and free from distortion or defects.

- C . Form pieces in longest possible lengths.
- D . Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- E . Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- F . Hem exposed edges 1/2 inch on unexposed side, miter and seam corners, unless noted otherwise.
- G . Cleats: Fabricate continuous cleats and starter strips from one gauge heavier material than sheet metal material, in widths required by SMACNA, interlockable with sheet.
- H . Fully soldered/welded stainless steel saddle and transition flashings at 3-D transitions such as roof to wall intersections, roof to elevator overrun, and the like.
- I . Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
- J . Expansion Provisions: Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection, and as required by SMACNA. Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- K . Shingle laps in flashings: 6-inch minimum, sealed with two distinct beads of bib-skinning butyl sealant at each lap.
- L . End Dams: For full soldered, welded, or seamless end dams at all flashing ends, 1-inch minimum.

2.5 ACCESSORIES

- A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B . Joints: Butt jointed with backing plate - lapping and rivets not permitted.
- C . Fasteners: AISI Type 304 or 316, stainless steel, with soft neoprene washers.
- D . Flexible Flashing:
 - 1. For use under metal copings and flashings:
 - 2. Basis of Design: Grace Ultra by GCP Applied Technologies.
- E . Slip Sheet:
 - 1. Rosin sized building paper.
- F . Protective Backing Paint: See Section 099000 - Painting and Coating.
- G . Sealant: As specified in Section 079005 – Joint Sealers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A . General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.5 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.6 SCHEDULE

- A . Head/Sill Flashings; Trims at new windows:

1. Profile: Custom per Architectural details.
2. Finish: Color to be selected from manufacturer's standards.
3. Location: Per architectural details.

- B . Sill Pan:

1. Application: SST A240/A240M Mill finish. Welded end dams.
2. Finish: Brushed.
3. Location: At new windows.

- C . Brake Shapes at Storefronts

1. Application: Trims and finishes adjacent to interior and exterior storefronts
2. Finish: Color to match adjacent storefront
3. Location: Per architectural details

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Penetration firestopping
- B . Fire resistive joint systems.

1.2 RELATED REQUIREMENTS

- A . 013000 – Administrative Requirements: For additional requirements of preinstallation meeting.
- B . 016000 – Product Requirements: For substitution and additional product requirements.
- C . 017419 – Construction Waste Management and Disposal: Limitations on disposal of removed material; requirements for recycling.
- D . 092116 – Gypsum Board Assemblies: For fire rated assemblies requiring firestopping.
- E . Divisions 21-28: For items typically penetrating fire rated assemblies requiring firestopping

1.3 ADMINISTRATIVE REQUIREMENTS

- A . Preinstallation Meeting: Convene one month before starting work of this section in accordance with Section 013000 - Administrative Requirements.

1.4 SUBMITTALS

- A . Qualification Data: For manufacturer and fabricator.
- B . Product Data: Provide product criteria, characteristics, accessories, and jointing methods, and termination conditions.
- C . Shop Drawings: Indicate system design listing by UL, FM Research, Intertek Testing Services, Omega Point Laboratories (OPL).
 - 1. Where system design listing is not available for a particular configuration provide an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) for submittal
- D . Contractor Installation log.
- E . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- F . Maintenance Data: For user's operation and maintenance of system including:
 - 1. Methods for maintaining system's materials.

1.5 QUALITY ASSURANCE

- A . Manufacturer of firestop products shall have been successfully producing and supplying these products for a period of not less than 3 years, and be able to show evidence of at least 10 projects where similar products have been installed and accepted.

- B . Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.6 WARRANTY

- A . Installation Warranty: Contractor shall correct defective Work within a five year period after Date of Substantial Completion.
- B . Manufacturer Warranty: Provide five year warranty for firestopping systems.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Interior Firestopping: Provide firestopping of all joints head of walls and penetrations in fire resistance rated and smoke-resistant assemblies. Single source installer.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A . Penetrations: Provide firestopping systems that resist the spread of fire, and the passage of smoke and other gases according to requirements indicated:
 - 1. Firestop all penetrations passing through fire resistance rated wall and floor assemblies and other locations as indicated on the drawings.
 - 2. Provide complete penetration firestopping systems that have been tested and approved by third party testing agency.
 - 3. F - Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E814, but not less than one hour or the fire-resistance rating of the construction being penetrated.
 - 4. T - Rated Through-Penetration Firestop Systems: Provide firestop systems with T ratings, in addition to F ratings, as determined per ASTM E814, where indicated by Code.
 - 5. Provide T-Rating Collar Devices tested in accordance with ASTM E814 or ANSI/UL 1479 for metallic pipe penetrations requiring T-Ratings per the applicable building code.
 - 6. L - Rated Through-Penetration Firestop Systems: Provide firestop systems with L ratings, in addition to F and T ratings, as determined per UL 1479, where indicated by Code.
 - 7. W - Rated Through-Penetration Firestop Systems: Provide firestop systems with W Water Resistance ratings, in addition to F, T and L ratings, as determined per UL 1479, where indicated.
- B . Perimeter Fire Containment Systems: Provide interior perimeter joint systems with fireresistance ratings indicated, as determined per ASTM E2307, but not less than the fireresistance rating of the floor construction.
- C . Fire-Resistive Joints: Provide joint systems with fire-resistance ratings indicated, as determined per UL 2079, but not less than the fire-resistance rating of the construction in which the joint occurs.
- D . For firestopping exposed to view, traffic, moisture, and physical damage, provide appropriate firestop systems for these conditions.

1. Exposed to view firestopping must be paintable.
- E. Firestop material must be able to be installed per manufacturers written instructions in temperatures ranging from 35 degrees F to 120 degrees F, and have the ability to be frozen, thawed and still comply with its UL designation and testing results.
- F. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
- G. Movement:
 1. Provide firestop sealants and fire resistive joint sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.
 2. Provide fire-resistive joint sealants designed to accommodate a specific range of movement and tested for this purpose in accordance with a cyclic movement test criteria as outlined in Standards, ASTM E-1399, ASTM E1966, or ANSI/ UL 2079.
- H. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.
- I. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.
- J. When mechanical cable pathways are not practical, openings within walls and floors designed to accommodate voice, data and video cabling shall be provided with re-enterable products specifically designed for retrofit.
- K. Penetrants passing through fire-resistance rated floor-ceiling assemblies contained within chase wall assemblies shall be protected with products tested by being fully exposed to the fire outside of the chase wall. Systems within the UL Fire Resistance Directory that meet this criterion are identified with the words "Chase Wall Optional".
- L. Provide penetration firestop systems, fire-resistive joint systems, or perimeter fire barrier systems subjected to an air leakage test conducted in accordance with Standard, ANSI/ UL 1479 for penetrations and ANSI/UL 2079 for joint systems with published L-Ratings for ambient and elevated temperatures as evidence of the ability of firestop system to restrict the movement of smoke.

2.3 MANUFACTURERS

- A. Specification is based on products listed in assemblies shown on Drawings.
 1. Comparable products by one of the following are also acceptable. See Section 016000 - Product Requirements for submittal requirements.
 - a. 3M Fire Protection Products.
 - b. HILTI, Inc.
 - c. Hydroflame.
 - d. Specified Technologies, Inc.
 2. Substitutions for products by manufacturers other than those listed above: See Section 016000 - Product Requirements.

2.4 ACCESSORIES

- A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping.

3.2 PREPARATION

- A . Priming: Prime substrates where recommended by 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.
- B . Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed. Remove tape as soon as it is possible to do so without disturbing the firestopping seal with substrates.
- C . Verify that system components are clean, dry, and ready for installation.
- D . Verify that field dimensions are as shown on the Drawings and as recommended by the manufacturer.

3.3 PENETRATION FIRESTOP INSTALLATION

- A . Ensure that all pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.
- B . Ensure that partitions and all other construction that conceal penetrations are not erected prior to the installation of firestop and smoke seals.
- C . Install forming/damming materials and other accessories in accordance with manufacturers written instructions.
- D . Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - 1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - 2. Install materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed finish to produce smooth, uniform surfaces.

3.4 FIRESTOP JOINT SYSTEMS INSTALLATION

- A . Install joint fillers to provide support of firestop materials during application.

- B . Provide at the position to produce the cross-sectional shapes and depths of installed firestop material relative to joint widths for optimum sealant movement capability and required fire resistance.
- C . Install systems that result in firestop materials:
 - 1. Directly contacting and fully wetting joint substrates.
 - 2. Completely filling recesses provided for each joint configuration.
 - 3. Providing uniform, cross-sectional shapes and depths relative to joint width that optimize movement capability.
- D . Tool non-sag firestop materials immediately after application and prior to skinning begins. Form smooth, uniform beads of configuration indicated or required to:
 - 1. Produce fire-resistance rating.
 - 2. Eliminate air pockets.
 - 3. Ensure contact and adhesion with sides of joint.

3.5 INSTALLATION LOG

- A . Include the following items for all firestop and fire resistive joint installations:
 - 1. Contractor's name, address, and phone number.
 - 2. Through-penetration firestop systems designation of applicable testing and inspecting agency.
 - 3. Date of installation.
 - 4. Firestop systems manufacturer's name.
- B . Provide as a pdf file with bi-directional links to floor plans and elevations to clearly illustrate location of material.

3.6 IDENTIFICATION

- A . Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems.

3.7 CLEANING

- A . Clean off excess fill materials and sealants adjacent to openings and joints as work progresses. Use methods and cleaning materials approved by manufacturers of firestopping products and or assemblies in which openings and joints occur.
- B . Protect firestopping during and after curing period from contact with contaminating substances.
- C . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.8 SCHEDULE

A . Firestopping:

1. Location: As required where modifying existing rated elements

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Sealants for exterior surfaces
- B . Sealants for interior surfaces.

1.2 RELATED REQUIREMENTS

- A . 016000 – Product Requirements: For substitution and additional product requirements.
- B . 017419 – Construction Waste Management and Disposal: Limitations on disposal of removed material; requirements for recycling.

1.3 SUBMITTALS

- A . Qualification Data: For manufacturer, installer, testing agency.
- B . Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C . Preliminary Selection Sample: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D . Field Samples for Confirmation: Provide sealant samples in the color selected based on Manufacturer's charts for sealants. Field samples shall be minimum 12 inches long and installed at joints intended for each particular sealant use. Field samples will be used to confirm sealant color selection.
- E . SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- F . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- G . Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.
- H . Compatibility and Adhesion Test 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.
- I . Field Test Report Log: For each elastomeric sealant application.
- J . Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

- K . Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- L . Maintenance Data: For user's operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 - 3. Recommendations on maintenance schedule.

1.4 QUALITY ASSURANCE

- A . Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.
- B . Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project. Minimum 5 years of documented experience in facilities of this size and scope.
 - 1. Prequalification of single source installers for exterior sealants is encouraged.
- C . Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.6 WARRANTY

- A . Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Joint sealers for properly designed joints in interior and exterior materials; selected for durability, movement capacity, adhesion to substrates and non-staining characteristics.

2.2 PERFORMANCE AND DESIGN CRITERIA

- 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 sealant manufacturer, based on testing and field experience.
- B . Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

- C . Elastomeric Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- D . Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

2.3 MATERIALS

A . Sealants for exterior surfaces:

1. Silicone Sealant: ASTM C920, Grade NS, Class 50, Uses NT, A, G, M, O; single component, general purpose, medium modulus, neutral curing, non-sagging, nonstaining, non-bleeding.
 - a. Movement Capability: +/- 50 percent.
 - b. Color: Standard colors matching finished surfaces.
 - c. Designed for weather-proofing typical exterior materials including unprimed adhesion to anodized and fluoropolymer coated aluminum.
2. Surface Modified Silicone Sealant: ASTM C920, Grade NS, Class 50, Uses NT, A, G, M, O; single component, general purpose, medium modulus, neutral curing, nonsagging, non-staining, non-bleeding.
 - a. Movement Capability: +/- 50 percent.
 - b. Color: Standard colors matching finished surfaces.
 - c. Designed for weather-proofing sensitive porous stone and light colored metal panel substrates.
3. Preformed Compressible Foam Sealers.
 - a. Movement +25%, -25% (50% total) - permanently elastic.
 - b. Color: Color as selected to match concrete.

B . Sealants for interior surfaces:

1. General Purpose Interior Sealant: polyurethane; single, or multi- component, paintable.
 - a. Color: Standard colors matching finished surfaces.
 - b. Designed for interior movement and non-moving joints adjacent to painted surfaces.
2. Acoustical Sealant: Latex sealant; ASTM C834.
 - a. Non-hardening type.
 - b. Tested as part of acoustical assemblies.
3. Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C920, Grade P, Class 25, Uses T, M and A; single or multi-component.
 - a. Approved by manufacturer for wide joints up to 1-1/2 inches.
 - b. Color: Standard colors matching finished surfaces.
 - c. Product: Vulkem 45 SSL by Tremco Inc.
 - d. Designed for exposed, trafficked joints with pourable self-leveling installation.

2.4 ACCESSORIES

A . Joint sealant backing:

1. General:

- a. Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

2. Cylindrical Sealant Backings:

- a. ASTM C1330, Type C (closed-cell material with a surface skin). B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

3. Bond-Breaker Tape:

- a. Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

B . Miscellaneous Materials:

1. Primer:

- a. Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction jointsealant- substrate tests and field tests.

2. Cleaners for Nonporous Surfaces:

- a. 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.

3. Masking Tape:

- a. a. Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

4. Natural Sand:

- a. Washed natural sand containing no contaminants that would affect the sealant. Color as approved by the architect for sanded joints as indicated or scheduled.

C . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A . Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A . General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B . Joint Sanding: Sand sealant joints at brick and sidewalks.
 - 1. Immediately after tooling and prior to skinning over of sealant, broadcast sand onto surface of sealant.
 - 2. Retool by rolling a dowel over the joint to achieve sufficient embedment.
 - 3. Maintain uniform appearance.

3.4 FIELD QUALITY CONTROL

- A . Field quality control to include field adhesion testing, field stain testing, test methods and evaluation of field test results.
- B . Perform all corrections necessary for issuance of warranty.

3.5 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.6 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.7 SCHEDULE

- A . Silicone:
 - 1. Manufacturer: Dow, GE, May, Pecora, Sika, Tremco.
 - 2. Application: One- or two-part silicone sealant ASTM 920 Grade NS, Class 50/100, Use NT.
 - 3. Finish: Color to be selected from manufacturer's standards.
- B . Silicone:
 - 1. Manufacturer: Dowsil 790.
 - 2. Application: Masonry.
- C . Silicone:
 - 1. Manufacturer: Dowsil 795.
 - 2. Application: Non-porous substrate.
- D . Polyurethane

1. Manufacturer: Sika, Tremco
2. Application: One- or two-part polyurethane sealant ASTM C920 Grade NS, Class 100/50, Use NT.
3. Finish: Color to be selected from manufacturer's standards.
4. Location: Exterior and interior movement joints not subject to traffic.

E . Polyurethane:

1. Manufacturer: BASF, Pecora, PSI, Sika, Tremco
2. Application: Polyurethane sealant, ASTM C920 Grade NS, Class 25, Use T.
3. Finish: Color to be selected from manufacturer's standards.
4. Location: Exterior and interior stationary joints subject to foot traffic.

F . Latex:

1. Manufacturer: BASF, Pecora, PSI, Tremco
2. Application: Acrylic latex or siliconized acrylic latex sealant, ASTM C834 Grade NF.
3. Finish: Color to be selected from manufacturer's standards.
4. Location: Interior stationary joints not subject to traffic.

G . Acoustic:

1. Manufacturer: Pecora AIS-919, USG Sheetrock acoustical sealant.
2. Application: Non-sag, non-staining ASTM C834, and acoustic tested per ASTM E90.
3. Finish: Color to be selected from manufacturer's standards.
4. Location: Acoustic sealant at STC rated assemblies.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Fully welded hollow metal door frames.

1.2 RELATED REQUIREMENTS

- A . 087100 - Door Hardware: For hardware installed in hollow metal doors.
- B . 088000 - Glazing: For glass in doors and borrowed lites.
- C . 099000 - Painting and Coating: For field painting.

1.3 SUBMITTALS

- A . Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes. Include U-value data for thermally broken doors and frames.
- B . Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- C . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- D . Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- E . Maintenance Data: For user's operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE

- A . Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Interior hollow metal frames for solid core wood doors.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A . Accessibility Requirements: For doors required to be accessible, comply with applicable provisions in the Accessible and Usable Building Facilities ICC A117.1 and 2010 ADA Standards for Accessible Design – Department of Justice.
- B . VOC Content: Provide adhesive and sealant products with VOC content equal to or less than 50 grams/Liter.
- C . Comply with ANSI A250.8 in general and for grade and style specified. NAAMM HMMA doors of equivalent or better construction are allowed.
- D . Provide hardware preparation in accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard. Coordinate with Section 087100 - Door Hardware.

2.3 MANUFACTURERS

- A . Specification is based on Doors and Frames by one of the following:
 - 1. Comparable products by one of the following are also acceptable. See Section 016000 - Product Requirements for submittal requirements.
 - a. Assa Abloy.
 - b. Ceco.
 - c. Curries.
 - d. Fleming.
 - e. Steelcraft.
 - 2. Substitutions for products by manufacturers other than those listed above: 016000 - Product Requirements.

2.4 MATERIALS

- A . Interior hollow metal door frames
 - 1. Performance Criteria:
 - a. Comply with the requirements of grade specified for corresponding door.
 - b. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 2.
 - c. Frames for Glass: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage.
 - 2. Features:
 - a. Assembly: Fully welded.
 - b. Finish: Factory primed, for field finishing.

2.5 ACCESSORIES

- A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B . Glazing: As specified in Section 088000 - Glazing, factory installed.

C . Mineral Fiber Insulation: For filling frame cavities.

2.6 FINISHING

A . Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.

B . Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

C . Field Finish: In accordance with Section 099000 - Painting and Coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A . Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

B . Coat inside of frames to be installed in masonry, with bituminous coating, prior to installation.

C . Coat inside of other frames with bituminous coating to a thickness of 1/16 inch.

3.3 INSTALLATION

A . General: Install all materials in accordance with manufacturer's instructions based on conditions present.

B . Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.

C . Install fire rated units in accordance with NFPA 80.

D . Seal seam at top closures after finish is applied to create a smooth surface without groove or pits.

1. Seal with sealant Per Section 079005 - Joint Sealers.

E . Pack all frames with insulation.

F . Coordinate installation of hardware.

G . Coordinate installation of electrical connections to electrical hardware items.

H . Touch up damaged factory finishes.

3.4 TOLERANCES

A . Clearances Between Door and Frame: As specified in ANSI A250.8.

B . Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.5 ADJUSTING

- A . Adjust and lubricate hardware for proper operation.
- B . Adjust for smooth and balanced door movement in accordance with manufacturer's instructions.

3.6 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.7 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.8 SCHEDULE

- 1. See door and frame schedule in drawings.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Interior wood doors

1.2 RELATED REQUIREMENTS

- A . 016000 - Product Requirements: For substitution and additional product requirements.
- B . 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C . 081113 - Hollow Metal Frames: For frames.
- D . 087100 - Door Hardware: For hardware installed in wood doors.
- E . 088000 - Glazing: For glass in doors and borrowed lites.
- F . 099000 - Painting and Coating: For field painting.

1.3 SUBMITTALS

- A . Qualification Data: For manufacturer.
- B . Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
- C . Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles.
- D . Sample: Submit two samples face material, manufacturer's standard size showing factory finishes, colors, and surface texture.
- E . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- F . Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- G . Maintenance Data: For user's operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE

- A . Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.6 WARRANTY

- A . Interior Doors: Provide manufacturer's warranty for the life of the installation.
 - 1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Wood doors for Hollow Metal Frames with Lites as described

2.2 PERFORMANCE AND DESIGN CRITERIA

- A . Accessibility Requirements: For doors required to be accessible, comply with applicable provisions in the Accessible and Usable Building Facilities ICC A117.1 and 2010 ADA Standards for Accessible Design – Department of Justice.
- B . Quality Level: Custom Grade, Extra Heavy Duty performance, in accordance with WDMA I.S. 1A for all doors with the following exceptions.
- C . Construction: Flush.
- D . Vertical Edges: Same species as face veneer.
- E . Edge type (AWI "E" type) edge set in between door face veneers.
- F . Door Edge Profile: Beveled on both edges.
- G . Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- H . Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- I . Source Limitations: For doors and frames, obtain products from single source from single manufacturer.
- J . Provide hardware preparation in accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard. Coordinate with Section 087100 - Door Hardware.

2.3 MANUFACTURERS

- A . Specification is based on doors and frames by one of the following:
 - 1. Graham Wood Doors: www.grahamdoors.com
 - 2. Lynden Doors: www.lyndendoor.com

3. VT Industries, Inc: www.vtindustries.com

B. Substitutions for products by manufacturers other than those listed above: See Section 016000 - Product Requirements.

2.4 MATERIALS

A. Finish:

1. Paint grade shop primed wood or manufactured wood veneer.
 - a. Size: 1 3/4" 5-ply.
 - b. HD hardboard crossbands.
 - c. WDMA I.S. 1-A, Heavy Duty.
 - d. Core: LD2 particleboard
 - e. Finish: Factory prime for field painting; smooth.
 - f. Location: Per door schedule.

B. Cores:

1. Cores Constructed with stiles and rails:
 - a. Provide solid blocks for hardware reinforcement.
 - b. Provide solid blocking for other throughbolted hardware.

2.5 ACCESSORIES

A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

3.3 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B. Field-Finished Doors: Trimming to fit is acceptable.
1. Adjust width of non-rated doors by cutting equally on both jamb edges.
 2. Trim maximum of 3/4 inch off bottom edges.
- C. Coordinate installation of hardware.
- D. Touch up damaged finishes.

3.4 TOLERANCES

- A . Conform to specified quality standard for fit and clearance tolerances.
- B . Conform to specified quality standard for telegraphing, warp, and squareness.

3.5 ADJUSTING

- A . Adjust and lubricate hardware for proper operation.
- B . Adjust for smooth and balanced door movement in accordance with manufacturer's instructions.

3.6 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.7 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Delegated design of storefront and entrances.
- B. Exterior storefronts
- C. Interior storefront and entrances.

1.2 RELATED REQUIREMENTS

- A. 01 60 00 - Product Requirements: For substitution and additional product requirements.
- B. 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C. 08 80 00 - Glazing: For glass infill.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 30 00 - Administrative Requirements.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Provide glazed storefronts that comply with test performance requirements indicated, as evidenced by reports based on Project-specific preconstruction testing or of tests performed on manufacturer's standard assemblies by a qualified testing agency.
- B. Preconstruction Sealant Testing: Perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition.
 - 1. Test a minimum five production-run samples each of metal, glazing, and other material.
 - 2. Prepare samples using techniques and primers required for installed assemblies.
 - 3. Perform tests under environmental conditions that duplicate those under which assemblies will be installed.
 - 4. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited

to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

1.5 SUBMITTALS

- A. Product Data: Provide product criteria, characteristics, accessories, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Include sealants tested and approved as part of entrance and storefront system.
 - 2. Indicate glazed storefronts comply with performance requirements indicated, as evidenced by tests performed on manufacturer's standard assemblies by a qualified testing agency
- B. Qualification Data: For manufacturer, installer, and design engineer.
- C. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Include plans, elevations, sections, full-size details, and attachments to other work. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior. Relationship to the work of others shall be clearly indicated when necessary to coordinate the work with other building trades.
- D. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include full-size isometric details of each vertical-to-horizontal intersection of glazed Storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage templates and details.
 - c. Interface with adjoining building construction.
 - d. Referenced to detail numbers indicated on the Contract Drawings.
 - e. Expansion and seismic provisions.
 - f. Glazing.
 - g. Entrance Systems.
- E. Coordination Drawings: Show tie-back and intermittent stabilization anchors.
 - 1. Include required slab edge configuration, post tensioning locations, embedded or surface attachment anchors and channels, structural supports such as steel posts and girts, and door locations.
- F. Product Test Reports:

1. Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed storefronts, indicating compliance with performance requirements.
- G. Sample: For each type of exposed finish required, in manufacturer's standard sizes.
- H. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- J. Maintenance Data: For user's operation and maintenance of system including:
 1. Methods for maintaining system's materials and finishes.
 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 3. Recommendations on maintenance schedule.
 4. Include ASTM C1401 recommendations for postinstallation-phase quality-control program.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.
- B. Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.8 WARRANTY

- A. Manufacturer's Finish Warranty: Correct defective work within a 10 year period after Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
 1. Finish Criteria are listed AAMA 2605.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Factory fabricated and finished aluminum framing system with infill, and related anchorage and attachment devices.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A. The storefront system begins at the primary structural members of the building frame and the edges of concrete slabs, include all support embeds, plates, angles and ancillary framing members required for structural integrity and support of the Storefront from the building structure.
- B. The Drawings:
 - 1. Indicate the design intent for profile, joints and configuration required together with relationship to structural frame and interior building elements.
 - a. Drawings do not purport to identify or solve completely the problems of fixings and anchorage or flatness and stability of facing.
- C. General Performance:
 - 1. Glazed storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Framing members transferring stresses, including those caused by structural movements to glazing.
 - c. Glazing-to-glazing contact.
 - d. Sealant failure.
 - e. Glass breakage.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Failure of operating units.
- D. Structural Performance:
 - 1. Deflection of Framing Members:
 - a. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each

individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

- 1) For spans over 13 feet 6 inches limit deflection to $L/240 + 1/4$ inch.
- b. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or 1/8 inch, whichever is smaller.
- c. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175. E.
Accessibility:
 1. Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be 5 pounds maximum.
 - a. ANSI/ICC A117.1 - 309.4 Operation.

2.3 MANUFACTURERS

- A. Specification is based on products listed below.
 1. Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 - Product Requirements.

2.4 EXTERIOR STOREFRONT SYSTEM

A. Basis of Design: Kawneer Trifab VersaGlaze 451T storefront

1. Storefront Features: 2" sightline; 4-1/2" depth
2. High Thermal Performance with integral thermal break
3. Color to match existing exterior windows

2.5 INTERIOR ENTRANCE SYSTEMS

A. Basis of Design: Kawneer Trifab VersaGlaze 450 storefront with 350 Non-Thermal Doors

1. Storefront Features: 1-3/4" sightline; 4-1/2" depth
2. Color to be selected from manufacturer's standard colors of 70% fluoropolymer-based coating.

2.5 GLAZING:

- A. Comply with Section 08 80 00 - Glazing.
- B. Glazing Gaskets, Spacers, Setting Blocks, Sealant Backings, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types compatible with sealants and suitable for joint movement and assembly performance requirements.

2.6 FINISHES:

- A. Basis of Design: Kawneer Permafluor Architectural Finishes 70% fluoropolymer-based coating.

1. Color(s) to be selected from Manufacturer's standards.
2. Color of storefront will vary based on location.

2.7 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

- B. Framing Sealants:

1. Manufacturer's standard sealants with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and 100 percent silicone.

- C. Manufacturer's recommended compensation head channels.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install glazed Storefronts to comply with the following nonaccumulating maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.

- b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
- 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.
 - 5. Allowances for cumulative effect of all tolerances (fabrication, assembly, thermal, seismic, building, and erection) and including the work of other sections, shall be made to ensure compliance with the above requirements.

3.5 ADJUSTING

- A. Adjust operating windows, ventilators, hardware, and accessories for smooth function and tight fit at contact points and weather stripping for smooth operation. Lubricate hardware and moving parts.
 - 1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge. The force required to activate operable parts shall be 5 pounds maximum.

3.6 CLEANING

- A. Dispose of all waste material in accordance with project's Waste Management Plan.
 - 1. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.7 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A . Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A . This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Other doors to the extent indicated.
- B . Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Cylinders specified for doors in other sections.
- C . Related Sections:
 - 1. Division 08 Section "Hollow Metal Frames".
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 4. Division 28 Section "Access Control Hardware Devices".
- D . Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E . Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 - 3. ANSI/UL 294 - Access Control System Units.

4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A . Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B . Door Hardware Schedule: Prepared by or under the supervision of supplier, 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. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 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.
- C . Shop Drawings: Details of electrified access control hardware indicating the following:
 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified 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.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

- G . Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- H . Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.
 - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I . At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B . 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.
- C . Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A . Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

- B . Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C . Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A . General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B . Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C . Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D . Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Five years for manual overhead door closer bodies.
 - 3. Ten years for manual overhead door closer bodies.
 - 4. Five years for motorized electric latch retraction exit devices.
 - 5. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

- 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.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A . General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

- B . Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part3. Products are identified by using door hardware designations, as follows:
1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C . Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A . Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
 5. Manufacturers:
 - a. Hager Companies (HA).
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
 - c. Stanley Hardware (ST).
- B . Pivots: ANSI/BHMA A156.4, Grade 1, certified. Space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.

1. Manufacturers:
 - a. Architectural Builders Hardware (AH).
 - b. Rixson Door Controls (RF).
- C. Sliding and Folding Door Hardware: Hardware is to be of type and design as specified and should comply with ANSI/BHMAA156.14.
 1. Sliding Bi-Passing Pocket Door Hardware: Provide complete sets consisting of track, hangers, stops, bumpers, floor channel, guides, and accessories indicated.
 2. Cascading: Provide a bi-parting or single direction telescoping system as required with a minimum 200 lb. per door capacity.
 3. Bi-folding Door Hardware: Rated for door panels weighing up to 125 lb.
 4. Pocket Sliding Door Hardware: Rated for doors weighing up to 200 lb.
 5. Manufacturers:
 - a. By door manufacturer
 - b. Hager Companies (HA).
 - c. Johnson Hardware (JO).
 - d. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 POWER TRANSFER DEVICES

- A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 1. Manufacturers:
 - a. Hager Companies (HA) - ETW-QC (# wires) Option.
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC (# wires) Option.
 - c. Stanley Hardware (ST) - C Option.
- B. Electrified Quick Connect Intermediate Transfer Pivots: Provide electrified offset intermediate transfer pivot hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 1. Manufacturers:
 - a. Architectural Builders Hardware (AH) - EL019-EZ (# wires).
 - b. Rixson Door Controls (RF) - E-M19-QC (# wires).

C . Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.
2. Manufacturers:
 - a. Hager Companies (HA) - Quick Connect.
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC-C Series.
 - c. Stanley Hardware (ST) - WH Series.

2.4 DOOR OPERATING TRIM

A . Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:
 - a. Door Controls International (DC).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).

B . Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).

2.5 CYLINDERS AND KEYING

- A . General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B . Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C . Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 4. Tubular deadlocks and other auxiliary locks.
 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 6. Keyway: Manufacturer's Standard.
- D . Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- E . High Security Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders certified to UL437, including pick and drill resistance. Pick resistance to incorporate two or more independent locking mechanisms including a pin tumbler device with six top pin chambers, mushroom-shaped driver pins, and coded sidebar locking mechanism operated independently from the six top pin tumbler device. Drill resistance to incorporate cylinder housing with fixed case-hardened inserts protecting the pin tumbler shear line, cylinder plugs with case-hardened inserts protecting both the pin tumbler shear line and the side bar, mushroom-shaped stainless steel driver pins, and stainless steel side pins. Cylinders to be factory keyed.
 1. New high security key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
 2. Manufacturers:
 - a. ASSA (AA) - Maximum+.
 - b. Corbin Russwin (RU) - Access 3 AHS.
 - c. Corbin Russwin (RU) - Pyramid PHS.
 - d. Medeco (MC) - Medeco 3.
 - e. Sargent (SA) - Degree DG3.
 - f. Sargent (SA) - KESO UL.

g. No Substitution.

F . Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

G . Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

H . Construction Keying: Provide construction master keyed cylinders.

I . Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

A . Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.7 MECHANICAL LOCKS AND LATCHING DEVICES

A . Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ML2000 Series.
 - b. Sargent Manufacturing (SA) - 8200 Series.
 - c. Yale Commercial(YA) - 8800FL Series.

2.8 ELECTROMECHANICAL LOCKING DEVICES

- A . Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below and in the hardware sets.
 - 1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.
 - 2. Manufacturers:
 - a. Yale Commercial(YA) - 8800FL Series.

2.9 LOCK AND LATCH STRIKES

- A . Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B . Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMAA156.13.
 - 2. Strikes for Bored Locks and Latches: BHMAA156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMAA156.36.
 - 4. Dustproof Strikes: BHMAA156.16.

2.10 CONVENTIONAL EXIT DEVICES

- A . General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - 1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 - 2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 - 3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B . Conventional Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Fabricate latchbolts from cast stainless steel, Pullman type, incorporating a deadlocking feature.
1. Manufacturers:
 - a. Yale Commercial(YA) - 6000 Series.
- C . Electromechanical Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.
1. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.
 2. Manufacturers:
 - a. Yale (YA) - 6000 Series.

2.11 DOOR CLOSERS

- A . All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B . Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - DC6000 Series.
 - b. Norton Door Controls (NO) - 8500 Series.
 - c. Sargent Manufacturing (SA) - 1431 Series.
 - d. Yale Commercial(YA) - 3500 Series.
 - e. Yale Commercial (YA) - 5800 Series.
- C . Door Closers, Surface Mounted (Standard Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - DC3000 Series.
 - b. Sargent Manufacturing (SA) - 1331 Series.
 - c. Yale Commercial(YA) - 2700 Series.
 - d. Norton Door Controls (NO) - 210 Series
- D . Door Closers, Overhead Concealed (Narrow Profile): ANSI/BHMA 156.4 Grade 1 Certified Products Directory (CPD) listed door closers designed for narrow profile frames and doors. Closers to have fully concealed body in the frame head for offset hung applications, with separate and independent valves for closing speed and backcheck adjustments and a decorative cover plate.
1. Manufacturers:
 - a. Rixson Door Controls (RF) - 91DCP Series.

2.12 ARCHITECTURAL TRIM

A . Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).

2.13 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 1. Manufacturers:
 - a. Rixson Door Controls (RF).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Sargent Manufacturing (SA).

2.14 ARCHITECTURAL SEALS

- A . General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B . Smoke Labeled Gasketing: Assemblies complying with NFPA105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C . Fire Labeled Gasketing: Assemblies complying with NFPA80 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 UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D . Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E . Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F . Manufacturers:
 - 1. National Guard Products (NG).
 - 2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
 - 3. Reese Enterprises, Inc. (RE).

2.15 ELECTRONIC ACCESSORIES

- A . Exit Delay Locking Systems: Exit delay locking systems are fully integrated units consisting of a minimum 1200 pound holding force magnetic lock, movement initiating device, reset bypass switch, and exit delay timer module. Unit to include an adjustable initiation gap allowing door travel of up to 1 inch before going into alarm condition. Operates on either 12VDC or 24VDC.
 - 1. Manufacturers:
 - a. Security Door Controls (SD) - 101 Exit Check Series.
 - b. Securitron (SU) - iMXD Series.
- B . Linear Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw plus 50% for the specified electrified hardware and access control equipment.
 - 1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

2. Manufacturers:
 - a. Alarm Controls (AK) - APS Series.
 - b. Securitron (SU) - BPS Series.
- C. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with an integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.
 1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 2. Manufacturers:
 - a. Securitron (SU) - AQD Series.
- D. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi-voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.
 1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 2. Manufacturers:
 - a. Securitron (SU) - AQL Series.

2.16 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.17 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Examine scheduled openings, 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 . Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A . Hollow Metal Doors and Frames: Comply with ANSI/DHIA115 series.
- B . Wood Doors: Comply with ANSI/DHIA115-W series.

3.3 INSTALLATION

- A . Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- 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."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C . Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 Division9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D . Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division7 Section "Joint Sealants."
- E . Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A . Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures” and “Cash Allowances”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.
 - 2. Submit documentation of incomplete items in the following formats:
 - a. PDF electronic file.
 - b. Electronic formatted file integrated with the Openings Studio™ door opening management software platform.

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

3.6 CLEANING AND PROTECTION

- A . Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B . Clean adjacent surfaces soiled by door hardware installation.
- C . Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A . Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A . The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handing and sizing all products.
 - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B . Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RF - Rixson
4. AD - Adams Rite
5. RO - Rockwood
6. YA - Yale
7. MC - Medeco
8. SU - Securitron

END OF SECTION 087100

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Delegated design of exterior and interior, monolithic glazing and insulated glazing units.
- B . Glass glazing.
- C . Exterior Insulated glazing.
- D . Interior Acoustic glazing
- E . Glazing coatings and frits.

1.2 RELATED REQUIREMENTS

- A . 016000 - Product Requirements: For substitution and additional product requirements.
- B . 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C . 081416 – Flush Wood Doors: For assembly requiring components from this section.
- D . 084313 Aluminum Framed Entrances and Storefronts

1.3 SUBMITTALS

- A . Qualification Data: For installer, fabricator and design engineer.
- B . Early Performance Criteria Design Submittal: Submit design package identifying the following criteria, used to design aluminum framed entrances and storefront systems:
 - 1. Load criteria, including seismic load criteria, wind load criteria.
 - 2. Design Loads, including wind loads at typical locations and corners, corner zone width, glass dead load, and glazing makeup.
 - 3. Anticipated movements, including the following:
 - a. Horizontal Joint Movement:
 - 1) Live load deflection.
 - 2) Thermal expansion.
 - 3) Long-term DL creep.
 - 4) Column shortening.
 - 5) Total Movement.
 - b. Elastic Story Drift.
 - c. Lateral Drift.
 - d. Parallel-to-Wall Deflection.
 - e. Cantilever Deflection of Framing Members

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

1. Provide specific shadowbox calculations to determine if ventilation of the cavity is required

D . Energy Performance Certificates: Certificates are required for this project including project specific frame types, spacer types and glass types. Project specific reports substantiate U-value, visual light transmission, and solar heat gain values required by the Energy Code for the project.

1. For projects following the Energy Code - Prescriptive Path: Submit NFRC Report with gateway sizes indicating compliance with requirements.
2. For projects following the Energy Code - Performance Path: Submit CMAST bid reports at time of product submittal. Prior to glazed assembly installation, submit NFRC-CMAST label certificates for the designed assemblies (not gateway sizes). Provide finite element computer thermal modeling and calculations per NFRC 100 and NFRC 200, using DOE/LBNL THERM 5.2 and WINDOWS 5.2 software.

E . Product Data:

1. Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
2. Glazing Compounds & Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements and identify available colors.

F . Shop Drawings: For any glazing installed with components from this section alone.

1. Submit shop drawings for glazing installed within other systems in accordance with the system submittal requirements.

G . Sample: Submit two samples in manufacturer's standard size of glass type units, showing coloration and design.

HI . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

I . Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

J . Maintenance Data: For user's operation and maintenance of system including:

1. Methods for maintaining system's materials and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE

A . Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

B . Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.

C . Installer Qualifications: Company specializing in performing the work of this section with

minimum 5 years of experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.6 WARRANTY

- A . Sealed Insulating Glass Units: Provide a ten (10) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- B . Laminated Glass: Provide a ten (10) year warranty to include coverage for delamination, including replacement of failed units.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Glazing and accessories installed as monolithic glazing or insulating glazing units within framing systems and support structures specified elsewhere.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A . Thermal Performance: Requirements Listed on window and door schedule.
 - 1. U-Value:
 - a. Prescriptive Energy Code Limits: Based on NFRC 100 gateway size.
 - 1) Fixed Glazing, including frame: U-value 0.45 maximum.
 - b. New exterior elements of the project must meet the standards of the Washington State Energy Code prescriptive requirements for glazing and openings.
 - 1) U-Value, Maximum: For glass and frames, fixed and operable based on project specific opening sizes, configurations, frame types, spacer types and glass types. Advertised U-values substantiated by NFRC Bid Reports at time of bid.
 - 2) U-Value Maximums are subject to change as the energy model is updated.
 - 2. Solar Heat Gain Coefficient (SHGC), Maximum: For the overall glazed assembly vision area and adjacent framing.
 - 3. Visible Light Transmission (VLT), Minimum: For the overall glazed assembly vision area and adjacent framing.
- B . By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C . Roll Wave Maximum Distortion Tolerance: 0.003 inch target with 0.005 inch maximum peak to valley measurement.
- D . Bow and Warp Maximum Tolerance: 50 percent of the maximum allowed in ASTM C1048.
- E . Thickness: As required for loads indicated.
- F . Deflection no greater than 1/175 of the longest dimension or 1/2 inch whichever is less.

2.3 GLASS GLAZING

A . Float Glass:

1. Performance Criteria:
 - a. By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - b. Roll Wave Maximum Distortion Tolerance: 0.003 inch target with 0.005 inch maximum peak to valley measurement.
 - c. Bow and Warp Maximum Tolerance: 50 percent of the maximum allowed in ASTM C1048.
 - d. Tinted Types: Performance and features to match basis of design product.
2. Annealed Type: ASTM C1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
3. Heat-Strengthened in accordance with ASTM C1048.
4. Fully Tempered in accordance with ASTM C1048.
 - a. Safety Glazing: Comply with 16 CFR 1201 test requirements for Category II..

B. INSULATED GLAZING UNITS

A . Fabricator:

5. Any of the manufacturers specified for float glass.
6. Any fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified performance, features and warranty.

B . Sealed Insulating Glass Units:

1. Performance:
 - a. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - b. IGU Performance: IGUs without spandrel glass to comply with ASTM E2188.
 - c. Resistance to Fogging: IGUs without spandrel glass to comply with ASTM E2189.
 - d. Edge Spacers: Material as required to meet performance criteria listed for assemblies.
 - 1) Color: Black.
 - e. Edge Seal: Glass to elastomer with supplementary silicone sealant.
 - 1) Color: Black.
 - f. Air Space: As scheduled below.

2.4 LAMINATED GLAZING

A . Laminated glazing for use in STC rated assemblies

1. Performance Criteria:
 - a. Type, thickness, and configuration as required to achieve STC rating of assembly
 - b. Provide products not requiring surface applied films to maintain their performance

criteria. Surface applied films can be easily damaged and performance criteria compromised.

- c. 1/2" overall maximum thickness; 1/4" overall thickness assumed to achieve STC rating with .045" PVB interlayer.

2. Features:

- a. Surface Finish: Ground and polished on both sides.

2.5 GLAZING COATINGS AND FRITS

A. Low-E Coated Vision Glass:

1. Features:

- a. Color: Neutral.
- b. Location: #2 surface of exterior units.

2.6 ACCESSORIES

A. Glazing Channels: Specification is based on CRL Wet Glaze U Channels by CRLaurence Co. Inc.

- 1. Comparable and substituted products will be judged based on the following performance criteria, features, warranty, and qualifications. See Section 016000 - Product Requirements for submittal requirements.
- 2. Features:
 - a. 1 inch deep base channel.
 - b. 2 inch deep top channel.
 - c. Finish: Satin Anodized.

B. Vertical Glazing Gasket: Specification is based on CRL EZ Glaze Soundstrip by CRLaurence Co. Inc.

- 1. Comparable and substituted products will be judged based on the following performance criteria, features, warranty, and qualifications. See Section 016000 - Product Requirements for submittal requirements.
- 2. Features:
 - a. Color: Clear
 - b. Depth: Selected to match glass panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on

conditions present.

3.4 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.5 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.6 SCHEDULE

A . Interior Storefront, Doors and Relites:

1. Manufacturer: Basis of Design: PPG
2. Application: Glass for field-assembled storefront systems and for doors and relites. Safety glazing (tempered and/or laminated) where required.
3. Location: Per plans.

B . Interior Laminated Acoustic Units:

1. Manufacturer: Basis of Design: Viracon
2. Application: ¼" overall: 1/8" glass, .045" PVB, 1/8" glass for STC rating of 35
3. Location: Per window schedule in all STC rated walls.

C . Exterior Insulated Units:

1. Manufacturer: Solarban 70 is basis of design
2. Application: Double glazed, low-E units with Argon fill.
3. Location: Per window schedule.
4. Additional Requirements: Glazing materials for field-assembled fenestration shall comply with NFRC rating and labeling criteria and with fenestrations manufacturer's NFRC simulation report. An NFRC label certificate is required for the installed assembly.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Glass mirrors.

1.2 RELATED REQUIREMENTS

- A . 016000 - Product Requirements: For substitution and additional product requirements.
- B . 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C . 102800 - Toilet Accessories

1.3 SUBMITTALS

- A . Product Data on Mirror Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- B . Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- C . Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
- D . Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A . Perform Work in accordance with GANA (GM) Glazing Manual for glazing installation methods.
- B . Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS), "Mirrors Handle with Extreme Care: Tips For the Professional on the Care and Handling of Mirrors."

1.5 FIELD CONDITIONS

- A . Do not install mirrors when ambient temperature is less than 50 degrees F.
- B . Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.6 DELIVERY, STORAGE, AND HANDLING

- A . As required by SMACNA Guideline Chapter 3

1.7 WARRANTY

- A . Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Frameless glass mirrors wall mounted with clips and adhesive.

2.2 PERFORMANCE AND DESIGN CRITERIA

2.3 MANUFACTURERS

- A . Mirrors:

1. Trulite Glass and Aluminum Solutions: www.trulite.com.
2. Binswanger Mirror/ACI Distribution: www.binswangerglass.com.
3. Lenoir Mirror Co: www.lenoirmirror.com.
4. Substitutions: See Section 016000 - Product Requirements.

2.4 MATERIALS

- A . Mirror Glass; General:

1. Select materials and/or provide supports as required to limit mirrored glass deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.

- B . Mirror Glass; Type:

1. ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality Q1 (mirror select); silvering, protective coating and physical characteristics complying with ASTM C1503; 6 mm minimum thick.

2.5 GLAZING ACCESSORIES

- A . Setting Blocks:

1. Neoprene, 80 to 90 Shore A durometer hardness.

- B . Spacer Shims:

1. Neoprene, 50 to 60 Shore A durometer hardness.

- C . Glazing Edges: Pencil Edges

E . Mirror Attachment Accessories:

1. Stainless steel J-profile channels at top and bottom.

F . Mirror Adhesive:

1. Chemically compatible with mirror coating and wall substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Verify that openings for mirrored glazing are correctly sized and within tolerance.
- B . Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive mirrors.

3.2 PREPARATION

- A . Clean contact surfaces with solvent and wipe dry.
- B . Seal porous glazing channels or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.
- C . Perform installation in accordance with ASTM C1193 for solvent release sealants. Install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION - GENERAL

- A . Install mirrors in accordance with GANA recommendations.
- B . Set mirrors plumb and level, free of optical distortion.
- C . Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D . Frameless Mirrors: Set mirrors with J-channel and adhesive, applied in accordance with adhesive manufacturer's instructions.
 - 1. Using a full bed of adhesive mount mirror to preservative pressure treated plywood backing.
 - 2. Support mirror until adhesive has set.

3.4 CLEANING

- A . Remove wet glazing materials from finish surfaces.
- B . Remove labels after work is complete.
- C . Clean mirrors and adjacent surfaces.
- D . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.5 PROTECTION

- A . After installation, mark pane with an 'X' by using removable plastic tape or paste.

3.6 SCHEDULE

- A . Wall Hung Mirrors:
 - 1. Application: Frameless glass mirrors with pencil edges, J channel at top and bottom.
 - 2. Finish: Pencil polish edge.
 - 3. Location: Toilet rooms in sizes per interior elevations

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Gypsum Sheathing.
- B . Gypsum Board.
- C . Acoustic Insulation.

1.2 RELATED REQUIREMENTS

- A . 016000 - Product Requirements: For substitution and additional product requirements.
- B . 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C . 061000 - Rough Carpentry: Building framing and sheathing.
- D . 078400 - Firestopping: Top-of-wall assemblies at fire rated walls.
- E . 079005 - Joint Sealers: Acoustic sealant.
- F . 092219 - Non-Structural Metal Framing: Blocking product and execution requirements.

1.3 SUBMITTALS

- A . Qualification Data: For Installer and design engineer.
- B . Product Data: Provide data on gypsum board, glass mat faced gypsum board, accessories, joint finishing system, and cement board.
- C . Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- D . Test Reports: For all stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.4 QUALITY ASSURANCE

- A . Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.
- B . Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
- B . As required by SMACNA Guideline Chapter 3

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Includes Gypsum wallboard finishing, metal trim and accessories, and acoustical sealants and insulation.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A . Provide completed gypsum board assemblies complying with ASTM C840 and GA-216.
- B . Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Sustained loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC ratings as specified in drawings, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C . Shaft Walls at Elevator and Stair Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Intermittent loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC ratings as specified in drawings, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
 - 3. Soft Body Impact: Meet or exceed Soft Body Impact Classification Level 2 measured in accordance with ASTM C1629/C1629M.
- D . Fire Rated Assemblies: Provide completed assemblies complying with UL listed assemblies indicated and ratings indicated on life safety drawings.
 - 1. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
 - 2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL Fire Resistance Directory.
- E . Interior Partitions Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC ratings as specified in drawings, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.3 MATERIALS

- A . Gypsum Sheathing:
 - 1. Sizes to minimize joints in place; ends square cut.
 - a. Application: Exterior sheathing and toilet rooms, unless otherwise indicated.
 - b. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - c. Glass-Mat-Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.

2. Core Type: Type X.
3. Thickness: 5/8 inch.
4. Glass-Mat-Faced Products: Georgia-Pacific Gypsum; DensGlass Sheathing; CertainTeed Gypsum, Inc.

B . Impact-Resistant Gypsum Board:

1. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1629/C1629, sizes to minimize joints in place; ends square cut.
 - a. Application: Use as indicated.
 - b. Type X: Thickness 5/8 inch.
 - c. Edges: Tapered.
 - d. Products:
 - 1) Georgia-Pacific Gypsum; ToughRock FireGuard X Abuse Resistant Gypsum Wallboard.
 - 2) CertainTeed Extreme Impact Resistant Gypsum Panels.
 - 3) National Gypsum; Hi-Impact XP Gypsum Wallboard.

C . Gypsum Board:

1. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - a. Application: Use for vertical surfaces, unless otherwise indicated.
 - b. Type X: Thickness 5/8 inch.
 - 1) Edges: Tapered.
 - 2) Products:
 - a) Georgia-Pacific Gypsum; ToughRock, and ToughRock Fireguard.
 - b) CertainTeed Gypsum, Inc.; GlasRoc.
 - c. Type C: Thickness: As indicated.
 - 1) Edges: Tapered.
 - 2) Products:
 - a) ToughRock FireGuard C Gypsum Wallboard.
 - b) CertainTeed Gypsum, Inc.; Type C Fire-Resistant Drywall.

D . Acoustic Insulation:

1. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3.5 inches, unless noted otherwise.

2.4 ACCESSORIES

- A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

B . Acoustic Sealant:

1. As specified in Section 079005 - Joint Sealers.

C . Finishing Accessories:

1. ASTM C1047, galvanized steel or rolled zinc, unless otherwise indicated.
 - a. Types: As detailed or required for finished appearance.
 - b. Special Shapes: In addition to conventional cornerbead and control joints, provide U-bead at exposed panel edges.

D . Joint Materials:

1. ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - a. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - b. Typical: Ready-mixed vinyl-based joint compound.
 - c. Exterior Soffits: Chemical hardening type compound.

E . High Build Drywall Surfer:

1. Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

F . Anchorage to Substrate:

1. Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A . General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B . Comply with ASTM C840 and GA-216. Install to minimize butt end joints, especially in highly visible locations.
- C . Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D . Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
- E . Exterior Soffit Board: Install perpendicular to framing, with staggered end joints over framing members or other solid backing.

- F . Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

- A . Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 - 2. At exterior soffits, not more than 30 feet apart in both directions.
 - 3. Review all proposed control joint locations with architect prior to installing.
- B . Corner Beads: Install at external corners, using longest practical lengths.
- C . Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.5 JOINT TREATMENT

- A . Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B . Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- C . Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5: As noted
 - 2. Level 4: Walls and Ceilings, typical
 - 3. Level 3: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
 - 5. Level 0: Temporary partitions and surfaces indicated to be finished in later stage of project.
- D . Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- E . Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- F . Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.6 FIELD OBSERVATION AT "PUNCH"

- A . Finish will be judged from a viewing difference of 4 feet.
- B . Ceilings will be viewed from a standing position.
- C . Finished lighting system or temporary lighting similar to proposed finished lighting should be used for judging the wall.

- D . Eye catching discrepancies and or blemishes, including “fuzzy” wall board surfaces, will be rejected.

3.7 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.8 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.9 SCHEDULE

A . Gypsum Board Assemblies:

1. Manufacturer: USG, National Gypsum Co, Georgia Pacific, CertainTeed Corp, American Gypsum.
2. Application: Non-load-bearing, steel-framed gypsum board assemblies designed to provide fire-rated enclosures capable of installation where only one side is accessible during construction.
3. Location: To be used at new mechanical shafts if required by construction limitations.

B . Shaftliner:

1. Manufacturer: CertainTeed ProRoc or manufacturer with similar recycled content.
2. Application: Gypsum shaftliner board, type X; ASTM C1396/C1396M.
3. Location: Per wall tags and typical assembly details.

C . Gypsum Board Typical:

1. Manufacturer: CertainTeed or manufacturer with similar recycled content.
2. Application: Gypsum board, installation and finishing: As specified in section 092900 "Gypsum Board."
3. Location: Per wall tags and typical assembly details.

D . Fire-Resistance Rated Assemblies:

1. Manufacturer: CertainTeed or manufacturer with similar recycled content.
2. Application: Fire-resistance-rated assemblies: Materials and construction identical to those tested according to ASTM E119.
3. Location: Per fire safety plan and wall/floor assemblies.

E . STC Rated Assemblies:

1. Manufacturer: CertainTeed or manufacturer with similar recycled content.
2. Application: STC-rated assemblies: Materials and construction identical to those tested according to ASTM E90 and classified according to ASTM E413.
3. Location: Per plans

F . Finish:

1. New Walls are to be Smooth finish (no spray texture).

2. Infill adjacent to plaster is to match existing plaster texture
3. Finish level as follows: (GA-214):
 - a. Level 1 (fire tape): Concealed locations above ceilings
 - b. Level 4: All visible locations.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Delegated design of non-structural metal framing.
- B. Metal partition, ceiling, and soffit and shaftwall framing.
- C. Blocking and backing panels.

1.2 RELATED REQUIREMENTS

- A. 01 60 00 - Product Requirements: For substitution and additional product requirements.
- B. 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C. 09 21 16 - Gypsum Board Assemblies: Execution requirements for anchors for attaching work of this section.

1.3 SUBMITTALS

- A. Qualification Data: For installer and design engineer.
- B. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. Shop Drawings: Indicate extents, special joint or termination conditions, and conditions of interface with other materials.
 - 1. Indicate acoustic details.
 - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- E. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.5 MOCKUP

- A. Mockup Size: Full height, minimum 12 feet long, including corner.
- B. Mockup may remain as part of the Work.
- C. The work of this section may be part of several different mockups. Coordinate with the mockups of other sections.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
- B. As required by SMACNA Guideline Chapter 3

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A. Perform Work in accordance with ASTM C754.
- B. Coordinate the placement of components to be installed within stud framing system.
- C. Suspended Assemblies: Coordinate 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.
- D. Design and install framing and furring to limit deflection to the following under point loads of 100 lbs and uniform loads as noted below except where required to withstand greater load (pressurized shafts and stairwells for example).
 - 1. Maximum Deflection of Vertical Assemblies:
 - a. Assemblies spanning single floor: Sustained loads of 5 lbf/sq ft with a maximum mid span deflection of 1:240.
 - b. Assemblies spanning multiple floors: Sustained loads of 7.5 lbf/sq ft with a maximum mid span deflection of 1:240.
 - 2. Maximum Deflection of Horizontal Assemblies: 1:240 deflection under dead loads and wind uplift.
 - 3. Maximum Deflection for assemblies under applied plaster finishes (Portland Cement or Gypsum) and ceramic tile is 1:360.

4. Use The SSMA Product Technical Information Book to look up the appropriate stud size, spacing and thickness.
- E. Ceiling and Soffit Framing:
 1. Seismic Requirements:
 - a. Classification: Conform to ASTM C635/C635M, Heavy Duty Classification.
 - b. Code Compliance: FBC, American Society of Civil Engineers ASCE 7 Section 13 and CISCA (AC) Guidelines.
- F. Acoustic Attenuation for Interior Partitions : STC's are calculated in accordance with ASTM E413 and based on published tests conducted in accordance with ASTM E90.
 1. Provide materials and construction identical to those tested in assembly indicated according to ASTM E90. See Section 09 21 16 for STC requirement.
- G. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.3 MATERIALS

- A. Metal partition, ceiling, and soffit and shaftwall framing.
 1. Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and "SSMA Product Technical Information" book for the spacing indicated<>.
 - a. Minimum Framing Component thickness is 20 Gage.
 - b. Studs: C shaped.
 - c. Runners: U shaped, sized to match studs.
 - d. Ceiling Channels: C shaped or T shaped.
 - e. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
 - f. Steel Stud Framing Connectors:
 - 1) Products:
 - a) Simpson Strong Tie, Bridging Connectors; DBC Bridging Connector: www.strongtie.com.
 - b) Substitutions: See Section 01 60 00 - Product Requirements.
 - g. Single leg Resilient channels.
 - h. "Z's": Used for several different members.

- i. Shaftwall framing CH and other sections as required for complete framing system.
 2. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 3. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - a. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
 - b. Material:
 - 1) Typical: ASTM A653/A653M steel sheet, SS Grade 50, with G40/Z120 hot dipped galvanized coating.
 - 2) Areas Subject to Moisture: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot dipped galvanized coating. Areas include exterior or nonconditioned space, shower rooms, locker rooms or other locations subject to regular wetting or high humidity.
 - c. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems.
 4. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.
 5. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
 6. Fasteners: ASTM C1002 self-piercing tapping screws.
 7. Anchorage Devices: Power actuated.
 - a. Also acceptable "Danback" flexible wood blocking system from Deitrich.
 - b. See backing schedule on architectural drawings.
 8. Anchorage Devices: Power actuated or Drilled expansion bolts.
 9. Acoustic Insulation: As specified in Section 09 21 16 - Gypsum Board Assemblies.
 10. Acoustic Sealant: As specified in Section 07 90 05.
 11. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.
- B. Blocking and backing panels.
1. Sheet Metal Backing (Blocking): 0.036 inch thick, galvanized. 4 inch minimum width
 - a. See backing schedule on architectural drawings.

2. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
3. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
4. Specifically, provide the following non-structural framing and blocking:
 - a. Cabinets and shelf supports.
 - b. Wall brackets.
 - c. Handrails.
 - d. Grab bars.
 - e. Towel and bath accessories.
 - f. Wall-mounted door stops.
 - g. Chalkboards and marker boards.
 - h. Wall paneling and trim.
 - i. Joints of rigid wall coverings that occur between studs.

2.4 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.
- C. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION OF STUD FRAMING

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

- B. Comply with requirements of ASTM C754.
- C. Extend partition framing to structure where indicated and to ceiling in other locations.
- D. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- E. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- F. At partitions indicated with an acoustic rating:
 - 1. Provide components and install as required to produce STC ratings as indicated.
 - 2. Place two beads of acoustic sealant (one on either side) between runners and substrate, studs, and adjacent construction.
 - 3. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.
 - 4. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- H. Backing and Blocking: Use steel channels or flat sheets secured to studs minimum 4" wide. Provide blocking for support of all wall hung items and equipment.
 - 1. Use sheet metal backing for reinforcement of 16 gauge minimum.
- I. Install supplementary framing and bracing at openings and terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer.
- J. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement:
 - 1. Where edges of suspended ceilings abut building structure at ceiling perimeters and at penetrations of structural elements.
 - 2. Where partition and wall framing abuts overhead structure.
 - 3. Where studs are installed directly against exterior walls of masonry or concrete, install asphalt felt strips between studs and wall.

3.4 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C754.

- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- E. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.
- I. Laterally brace suspension system.
 - 1. Sway-brace suspension systems with hangers used for support.

3.5 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.
- C. Level ceiling to a tolerance of 1/1200. For tilted ceilings maintain this tolerance as a "flatness" tolerance.

3.6 CLEANING

- A. Dispose of all waste material in accordance with project's Waste Management Plan.
 - 1. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.7 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.8 SCHEDULE

- A. Interior Assemblies: Finish: G40, Sizes: Profiles indicated, Metal Thickness: As required to meet performance criteria.

- B. Exterior Assemblies: Finish: G90, Sizes: Profiles indicated, Metal Thickness: As required to meet performance criteria.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Resilient sheet flooring.
- B . Resilient base.
- D . Resilient installation accessories.

1.2 RELATED REQUIREMENTS

- A . 013000 - Administrative Requirements: For additional requirements of preinstallation meeting.
- B . 016000 - Product Requirements: For substitution and additional product requirements.
- C . 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- D . 035400 - Cast Underlayment.
- E . 090510 - Flooring Moisture Measurement and Mitigation: Concrete moisture testing and mitigation systems.

1.3 ADMINISTRATIVE REQUIREMENTS

- A . Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 013000 - Administrative Requirements.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 SUBMITTALS

- A . Qualification Data: For installer.
- B . Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C . Shop Drawings: Indicate seaming plan.
- D . Flooring Sample: Submit two samples, 6 x 6 inch in size illustrating color and pattern for each resilient flooring product specified; heat weld rod samples for selection.
- E . Base and Accessory Samples: Submit manufacturer's complete set of color samples for initial selection.
- F . Certificate: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- G . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

I. Maintenance Data: For user's operation and maintenance of system including:

1. Methods for maintaining system's materials and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
3. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.5 MAINTENANCE MATERIAL

A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Flooring Material: 10 square feet of each type and color.
2. Extra Wall Base: 20 linear feet of each type and color.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As required by SMACNA Guideline Chapter 3

B. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.8 WARRANTY

A. Provide minimum Manufacturers Limited 5 year commercial warranty for manufacturing defects.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Resilient sheet and tile flooring, resilient stair accessories, resilient base and installation accessories for transition to other flooring types.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

2.3 RESILIENT SHEET FLOORING

A. (RF-2) Vinyl Sheet Flooring: 100 percent virgin composition, color and pattern through total

thickness.

1. Basis of Design: Mohawk Mendella.
2. Performance Requirements:
 - a. Homogenous sheet good.
 - b. Minimum Requirements: Comply with ASTM F1913, without backing and .
 - c. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
3. Features:
 - a. Total Thickness: 0.079 inch minimum.
 - b. Sheet Width: 72 inch minimum.
 - c. Profile: Flat.
 - d. Pattern: To be selected from manufacturer's standards.
4. Integral Cove Base:
 - a. 4 inch minimum height with 3/8 inch minimum radius.
5. Seamless Installation: Chemically bonded

2.4 RESILIENT BASE

- A . (WB-2) Resilient Base: ASTM F1861, top set Style A straight, and as follows:
1. Basis of Design product, height and profile: Pinnacle Series by Roppe; 4 inches high.
 2. Type: Thermoset Rubber Base.
 3. Thickness: 0.125 inch thick.
 4. Material: TS - Thermoset Vulcanized Rubber
 5. Finish: Satin.
 6. Color: To be selected by Architect from manufacturer's standards.
 7. Styles: B - Cove
 8. Length: Roll (4 foot sections are not acceptable except as maintenance stock).
- C . Comparable products by one of the following are also acceptable. See Section 016000 - Product Requirements for submittal requirements.
1. Burke Flooring: www.burkemercer.com.
 2. Johnsonite, a Tarkett Company: www.johnsonite.com.
 3. Roppe Corp: www.roppe.com.
 4. Substitutions for products by manufacturers other than those listed above: See Section 016000 - Product Requirements.

2.5 RESILIENT INSTALLATION ACCESSORIES

- A . (RA#) Cap for cove carpet, cap for cove resilient flooring, carpet bar for tackless installations, carpet edge for glue-down applications, nosing for carpet, nosing for resilient flooring, reducer strip for resilient flooring, joiner for tile and carpet, transition strips.

1. Basis of Design Product: Products by manufacturer of resilient flooring or base. Comparable and substituted products will be judged based on color match and available profiles.
 - a. Comparable products by one of the following are also acceptable. See Section 016000 - Product Requirements for submittal requirements.
 - 1) Burke Flooring: www.burkemercer.com.
 - 2) Johnsonite, a Tarkett Company: www.johnsonite.com.
 - 3) Roppe Corp: www.roppe.com.
 - 4) Substitutions for products by manufacturers other than those listed above: See Section 016000 - Product Requirements.
2. Profile and Dimensions: As indicated or required for conditions present.
3. Colors and Patterns: As selected from full range of industry colors.
4. Locations: Provide rubber molding accessories in areas indicated and as recommended by flooring manufacturer for complete installation.

2.6 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Electrostatic Dissipative Adhesive:
 1. Provide Manufacturer's recommended Static Dissipative Tile Adhesive and copper ground-connection strips for under the tile.
- C. Copper Conductors:
 1. As required for installation
- D. Subfloor Filler:
 1. White premix latex; type recommended by adhesive material manufacturer.
- E. Primers, Adhesives, and Seaming Materials:
 1. Waterproof; types recommended by flooring manufacturer.
- F. Moldings, Transition and Edge Strips:
 1. Same material as flooring.
- G. Filler for Coved Base:
 1. Plastic.
- H. Sealer and Wax:
 1. Types recommended by flooring manufacturer.
 2. Heat Weld Rod
 - a. Color to closely match resilient flooring, as selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Verify existing conditions meet the manufacturer's requirements before starting work.
- B . Verify existing conditions meet the manufacturer's requirements before starting work, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- C . Verify that wall surfaces are smooth and flat within the tolerances specified, are dust-free, and are ready to receive resilient base.
- D . Cementitious Subfloor Surfaces: Verify that substrates meet moisture, internal relative humidity and alkalinity requirements of flooring and adhesive manufacturers in accordance with Section 090510 - Flooring Moisture Measurement and Mitigation.
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- E . Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A . General:
 - 1. Install all materials in accordance with manufacturer's instructions based on conditions present.
 - 2. Starting installation constitutes acceptance of subfloor conditions.
 - 3. Fit joints tightly.
 - 4. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
 - 5. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - a. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
 - b. Resilient Strips: Attach to substrate using adhesive.
 - 6. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
 - 7. Install flooring in recessed floor access covers, maintaining floor pattern.
 - 8. At movable partitions, install flooring under partitions without interrupting floor pattern.
 - 9. Turn sheet flooring up 4 inches to create integral cove base. Heat weld corner seams.
 - 10. Seamless Installation:
 - a. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.4 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.
- B . Remove excess adhesive from floor, base, and wall surfaces without damage.
- C . Initial cleaning and finishing is the responsibility of the contractor.
 - 1. Follow manufacturer's recommendations for initial cleaning and finishing procedures.
 - 2. Not all types of flooring require finishing.

3.5 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

3.6 SCHEDULE

- B . Rubber Flooring with Integrated Cove Base:
 - 1. Manufacturer: Mohawk Mendella.
 - 2. Application: Rubber sheet flooring.
 - 3. Finish: Color to be selected from standards.
 - 4. Location: Per finish schedule.
- C . Roppe Pinnacle Rubber Floor Base:
 - 1. Manufacturer: Roppe.
 - 2. Application: 4" cove base.
 - 3. Finish: Color to be selected from standards.
 - 4. Location: per finish schedule (public spaces to have wood base per 062023).

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Patterned Carpet Tile.
- B. Walk-off mat tile.

1.2 RELATED REQUIREMENTS

- A. 01 60 00 - Product Requirements: For substitution and additional product requirements.
- B. 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.3 SUBMITTALS

- A. Qualification Data: For installer.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate layout of joints and transitions between patterns.
- D. Flooring Sample: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Accessory Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- F. Certificate: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- G. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- I. Maintenance Data: For user's operation and maintenance of materials including:
 - 1. Methods for maintaining materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 - 3. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.4 MAINTENANCE MATERIAL

A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Flooring Material: 3 percent of each type and color (minimum of 10 yards) each type and color.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.7 WARRANTY

A. Provide minimum Manufacturers Limited 5 year commercial warranty for manufacturing defects.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. Carpet tile flooring installed fully adhered and walk-off mat tile.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
- B. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").

2.3 CARPET TILE

A. Carpet Tile: Manufactured in single dye lot, conforming to the following criteria:

1. Brand: Milliken.
 - a. Product: Moraine carpet tile
 - b. Color: (3) Colors/Patterns per finish schedule
 - c. Size: square
 - d. Location: as described in drawings

B. Walk-Off Mat Tile:

1. Basis of Design: Obex CutX Entrance Flooring by Milliken.
2. Material Options: CutX.

3. Size: 24" square
4. Application: High-traffic areas.
5. Location: As indicated on Drawings.

2.4 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Subfloor Filler: Type recommended by adhesive material manufacturer.
- C. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
- D. Transitions at flooring edges: Schluter transitions as described in drawings at each product termination
- E. Rubber base (where occurs): 09 65 00 - Resilient Flooring.
- F. Wood base (where occurs) 06 20 00 – Finish Carpentry
- G. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates meet moisture, internal relative humidity and alkalinity requirements of flooring and adhesive manufacturers in accordance with Section 09 05 10 - Flooring Moisture Measurement and Mitigation.
 1. Obtain instructions if test results are not within limits recommended by carpet manufacturer and adhesive materials manufacturer.
- C. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. General:

1. Install all materials in accordance with manufacturer's instructions based on conditions present and CRI Carpet Installation Standard.
2. Blend carpet from different cartons to ensure minimal variation in color match.
3. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
4. Lay carpet tile in pattern scheduled in Finish Legend on Drawings, with pile direction parallel to next unit, set aligned as indicated on shop drawings.
5. Starting installation constitutes acceptance of subfloor conditions.
6. Fit joints tightly.
7. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
8. Adhere carpet tile to substrate along centerline of rooms, at perimeter of rooms, where tiles are cut, and at 15 foot intervals throughout rooms. Lay remainder of tile dry over substrate.
9. Trim carpet tile neatly at walls and around interruptions.
10. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - a. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
 - b. Resilient Strips: Attach to substrate using adhesive.

3.4 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean and vacuum carpet tile surfaces in accordance with manufacturer's instructions.
- C. Dispose of all waste material in accordance with project's Waste Management Plan.
 1. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.5 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Acoustical large format ceiling panel systems.
- B. Accessories as required for complete installation.

1.2 RELATED REQUIREMENTS

- A. 01 60 00 - Product Requirements: For substitution and additional product requirements.
- B. 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.3 SUBMITTALS

- A. Qualification Data: For manufacturer and installer.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Specimen warranty.
- C. Test Reports: Certified test data from an independent test agency verifying that wall systems meet specified requirements for acoustical and fire performance.
- D. Shop Drawings: Elevations and reflected ceiling plans indicating layouts of panels, locations of seams, and details indicating typical transitions to other finish surfaces. Include details of inside and outside corners and backing at fixtures mounted within panels.
- E. Verification Samples:
 - 1. For each textile specified, minimum size 8 inches square, representing actual product in color, texture, and pattern.
 - 2. Accessory package.
- G. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Supply an additional 10 percent of accessories installed for Owner's use in maintenance of project.
2. Supply an additional 5 percent of panels installed for Owner's use in maintenance of project.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide all components of acoustical wall systems by a single manufacturer, including recommended primers, adhesives, and sealants.
- B. Installer Qualifications: Firm specializing in site-fabricated wall systems, with not less than 2 years of documented experience in installing wall systems of the type specified, and approved by the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. As required by SMACNA Guideline Chapter 3

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Large format felt acoustical ceiling components and supports.

2.2 MATERIALS

- A. Architectural Acoustic Felt Ceiling Clouds:
 1. Description: 1/2" thick, 100% polyester thru-color suspended ceiling clouds with 1-1/2" integral Acoustic Backer
 2. Manufacturer: Basis of design: Polysorb
 3. NRC Rating: .60 minimum
 4. Dimensions: 48 x 108 panels maximum size; installed size per drawings.
 5. Finish Layer: Integral color and full range of manufacturer's selections. See finish schedule for quantity of colors to be used in project.
 6. Installation: Cable suspension with manufacturer's supplied hardware to underside of existing concrete deck.
 7. Location: Per reflected ceiling plans
- B. Architectural 2x2 Acoustic Ceiling Tile in 7/8" T-Bar Grid
 - a Existing to be reused and salvaged.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify that all mechanical and electrical items and other finished items abutting acoustical ceiling systems have been installed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove ceiling plates and other obstacles, and prepare substrates to receive new anchors in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. Suspension using manufacturer's supplied fasteners and fittings.
 - 1. Spacing and style of fasteners per manufacturer
 - 2. Furring and supports mechanically attached to ceiling.

3.4 CLEANING

- A. Dispose of all waste material in accordance with project's Waste Management Plan.
 - 1. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Interior paint systems.
- B . Exterior paint systems.

1.2 RELATED REQUIREMENTS

- A . 013000 - Administrative Requirements: For additional requirements of preinstallation meeting.
- D . 016000 - Product Requirements: For substitution and additional product requirements.
- E . 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- F . 050513 - Shop-Applied Coatings for Metal: For factory applied finishes.

1.3 ADMINISTRATIVE REQUIREMENTS

- A . Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 013000 - Administrative Requirements.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 SUBMITTALS

- A . Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.
- B . Sample: Submit three paper chip samples, 8.5 x 11 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.
- C . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- D . Maintenance Data: For user's operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 - 3. Recommendations on maintenance schedule.

1.5 QUALITY ASSURANCE

- A . Manufacturer Qualifications: Company specializing in the manufacture of paint and coating products used in the work of this section with minimum ten years of experience.
- B . Installer Qualifications: Company specializing in performing the work of this section with

minimum 5 years of experience on projects of similar size and complexity.

1.6 DELIVERY, STORAGE, AND HANDLING

- A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
- B . As required by SMACNA Guideline Chapter 3

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Surface preparation and field application of paints, stains, varnishes, and other coatings.

2.2 MANUFACTURERS

- A . Provide all paint and coating products used in any individual system from the same manufacturer; unless noted otherwise below.
- B . Paints:
 - 1. Basis of Design: B-M: Benjamin Moore & Co: www.benjaminmoore.com.
- C . Substitutions for products by manufacturers other than those listed above: See Section 016000 - Product Requirements.

2.3 MATERIALS

- A . Interior paint systems:
 - 1. Paint interior surfaces in accordance with the following MPI Painting Manual designations.
 - 2. Acrylic-Enamel.
 - a. Substrate: Concrete, Concrete Masonry Units, Gypsum Board..
 - b. Benjamin Moore & Company:
 - 1) Primer: 046 Fresh Start 100% Acrylic Superior Primer.
 - 2) Top coat: 526 Aura Waterborne Satin (2 coats min.).
 - c. Sherwin Williams:
 - 1) Primer: PrepRite ProBlock Interior/Exterior Latex Primer, B51-600 Series (4.0 mils wet, 1.4 mils dry).
 - 2) Top Coat: Duration Home Interior Latex Satin, A97-1200 Series (4 mils wet, 1.6 mils dry per coat).
 - 3) Alternate Top Coat: S-W ProMar 200 HP Zero VOC Latex Eg-Shel, B20-1900 Series (4 mils wet, 1.7 mils dry per coat)
 - 3. Epoxy.
 - a. Substrate: Concrete, Concrete Masonry Units, Gypsum Board.
 - b. Benjamin Moore & Company:

- 1) Primer: 253 Super Spec Latex Primer Sealer & Enamel Undercoat, 1.1 mils.
 - 2) Top coat: P43-86 Super Spec HP Acrylic Epoxy Semi-Gloss 1.0-2.0 mils.
 - c. Sherwin Williams:
 - 1) Primer: Quick Dry Interior/Exterior Latex Stain Blocking Primer, B51W8670 (4 mils wet, 1.1 mils dry per coat).
 - 2) Top Coat: S-W Pro Industrial Water Based Catalyzed Epoxy Gloss B73-300 Series (5.0 mils wet, 2.0 mils dry per coat).
 - 3) Alternate Top Coat: S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series (4.0 mils wet, 1.4 mils dry per coat).
- B . Exterior paint systems:
1. Elastomeric Finish
 - a. Substrate: Concrete
 - b. BOD: Benjamin Moore
 - 1) Primer: Benjamin Moore Ultra Spec Masonry Int/Ext Acrylic High Build Masonry Primer
 - 2) Finish: Ultra Spec Masonry Elastomeric Waterproof Coating Low Lustre

2.4 ACCESSORIES

- A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

1.1 EXAMINATION

- A . Verify existing conditions meet the manufacturer's requirements before starting work.

1.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

1.3 INSTALLATION

- A . General: Install all materials in accordance with manufacturer's instructions based on conditions present.

1.4 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

1.5 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

1.6 SCHEDULE

A . Coats:

- 1. Application: Primer + 2 coats.

B . Interior Systems:

- 1. Manufacturer: Benjamin Moore Aura or similar.
- 2. Application: Interior paints, latex or high performance architectural latex. Zero VOC.
- 3. Finish: Sheen TBD from flat to semi-gloss dependent on location/substrate.
- 4. Location: Per finish schedule.

C . Exterior Systems:

- 1. Product: Water based elastomeric.
- 2. Manufacturers: Benjamin Moore or approved equal.
- 3. Coats: Prime + 2 coats.
- 4. Location: Exterior Concrete where required by scope of work. Color match existing.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Delegated design of signage and supports.
- B . Panel Signs for room identification and code requirement.

1.2 RELATED REQUIREMENTS

- A . 013000 - Administrative Requirements: For additional requirements of preinstallation meeting.
- B . 016000 - Product Requirements: For substitution and additional product requirements.
- C . 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.3 ADMINISTRATIVE REQUIREMENTS

- A . Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 013000 - Administrative Requirements.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 SUBMITTALS

- A . Qualification Data: For fabricator and design engineer.
- B . Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C . Product Data: Provide product criteria, characteristics, accessories, jointing and attachment methods.
- D . Shop Drawings:
 - 1. Show sign mounting heights, locations of supplementary supports, and accessories.
 - 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- E . Sample: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
 - 1. Panel Signs: Not less than 12 inches square for each type.
 - 2. Accessories: One of each, for each type.
- F . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- G . Maintenance Data: For user's operation and maintenance of system including:

1. Methods for maintaining system's materials and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
3. Include manufacturers' brochures and parts lists describing the actual materials installed.

H . Closeout Submittals:

1.5 MAINTENANCE MATERIAL

A . Spare parts, extra stock, tools.

1.6 QUALITY ASSURANCE

A . Manufacturer Qualification: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.

B . Designer Qualifications: Professional structural engineer with 5 years of documented experience in design of this work and licensed in the location of the project.

C . Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

D . Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.7 DELIVERY, STORAGE, AND HANDLING

A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

B . As required by SMACNA Guideline Chapter 3

PART 2 - PRODUCTS

2.1 DESCRIPTION

A . Signage as required by code and to facilitate wayfinding.

2.2 PERFORMANCE AND DESIGN CRITERIA

A . Tactile and Braille Characters: Text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Produce precisely formed characters with square-cut edges free from burrs and cut marks. Text shall be accompanied by Grade 2 Braille. Braille dots with domed or rounded shape produced using Raster Method.

1. Raised-Copy Thickness: Not less than 0.7 mm and not more than 3 mm.

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.

2.3 MATERIALS

- F . Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- G . Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
 - 1. Impact Resistance: 16 ft-lb/in. per ASTM D256, Method A.
 - 2. Tensile Strength: 9000 lbf/sq. in. per ASTM D638.
 - 3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. per ASTM D790.
 - 4. Heat Deflection: 265 degrees F at 264 lbf/sq. in. per ASTM D648.
 - 5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.
- H . Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils (0.076 mm) with pressure-sensitive adhesive backing, suitable for exterior applications.
 - 1. Opaque Vinyl: Basis of Design: 3M Scotchcal Electro Cut Graphic Film, or a comparable product by the following:
 - a. Gerber Scientific Products.
 - 2. Translucent Vinyl: Basis of Design 3M Scotchcal Electro Cut Graphic Film, Dusted Crystal Translucent Vinyl, or a comparable product by the following:
 - a. Gerber Scientific Products.
 - 3. Printed Vinyl Sheet: Digitally printed vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing. Apply UV and water resistant coating to face of sheet. Apply sheet to panels indicated.

2.4 FINISHES

- C . Painted Finishes: Specification is based on products listed by Matthews Paint.
 - 1. Comparable products by one of the following are also acceptable. See Section 016000 - Product Requirements for submittal requirements.
 - a. Akzo Nobel.
 - 2. Substitutions for products by manufacturers other than those listed above: See Section 016000 - Product Requirements.
 - 3. Acrylic, Polycarbonate:
 - a. Primer: 74 777SP Tie Bond 0.4 - 0.6 mils DFT.
 - b. Topcoat: VOC MAP, 2.0 mils DFT minimum, satin sheen unless indicated otherwise.
 - 4. Clear Coat:
 - a. VOC 281 228SP VOC Satin Clear, 2.0 mils DFT minimum, satin sheen unless indicated otherwise.

2.5 FABRICATION

- C . Panel Signs:
 - 1. Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner signs.

2. Edge Condition: Square.
3. Corner Condition: Square.
4. Mounting: Unframed, as indicated.
 - a. Wall or Projection mounted with concealed attachment.
 - b. Manufacturer's standard anchors for substrates encountered.
5. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors.

E . Applied Decal Signs:

1. Applied Vinyl Characters: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing. Apply copy to surfaces indicated.

2.6 ACCESSORIES

- A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B . Manufacturer's optional accessories required by the project:
1. Double sided stick tape.
 2. Blank back plate - for glass.
 3. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A . General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 ADJUSTING

- A . Adjust and lubricate hardware for proper operation.

3.5 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.6 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.7 SCHEDULE

A . Room Identification and Code Required Signage in Staff Workspaces:

1. Application: Room/bathroom/occupancy/etc. signage with braille as required. Dark background with light text to meet contrast and letter height standards.
2. Finish: 1/8" acrylic lens with subsurface paint. Font and color to be selected by Architect.
3. Location: All rooms in staff areas where required by code.

B . Room Identification and Code Required Signage in Public Spaces:

1. Custom signage. Off-the-shelf signage will not be accepted.
2. Applications:
 - Adjacent to each swing door in new Library Spaces for room identification and naming. Finish Size: 8" x 6".
 - Maximum occupancy for each new library space
 - Tactile "exit" for each new library space
3. Finish: 1/8" acrylic lens with subsurface paint. Font and color to be selected by Architect. Braille to be clear applied to surface.
 - Where applied to glass, provide solid color back plate.
4. Location: Meeting 014, Meeting 013, Staff 012 (in public hallway only), Staff 004 (in public hallway only) Meeting 011

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Plastic sheet wall protection.
- B. Fiber reinforced plastic sheet.
- C. Stainless Steel Corner Guards

1.2 RELATED REQUIREMENTS

- A. 01 60 00 - Product Requirements: For substitution and additional product requirements.
- B. 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.3 SUBMITTALS

- A. Product Data: Provide product criteria, characteristics, accessories, jointing and methods, and termination details for curtains, track and accessories.
- B. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- C. Maintenance Data: For user's operation and maintenance of system including:
 - 1. Methods for maintaining system's hardware, operation, materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 - 3. Recommendations on maintenance schedule.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum of 5 years of experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.6 WARRANTY

- A. Installation Warranty: Contractor shall correct defective Work within a 2 year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Surface applied wall protection including plastic sheet wall protection and fiber reinforced plastic laminate.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.3 MATERIALS

- A. Plastic Sheet Wall Protection:

- 1. Solid Surface material wall protection:
 - a. Manufacturer: Acrovyn Plastic Wall Covering.
 - b. Location: Staff Areas per Plan
 - c. Color: To be selected from full line of Manufacturer's Standards

- B. Fiber Reinforced Plastic Sheet (FRP):

- 1. Manufacturer: Crane Plastic Laminate Wall Covering.
- 2. Finish: Smooth.
- 3. Color: White.
- 4. Location: Toilet Rooms per interior elevations.
- 5. Trims: Aluminum. See Accessories

- C. Corner guards.

- 1. Stainless Steel Corner Guards:
 - a. Basis of Design: Stainless Steel Corner Guard by InPro Corporation.
 - 1) Comparable products by one of the following are also acceptable. See Section 01 60 00 - Product Requirements for submittal requirements.
 - a) Construction Specialties Inc.

2) Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 - Product Requirements.

- b. Material: 304 Stainless steel.
- c. Finish: #4 Satin.
- d. Height: Top of floor base to ceiling.
- e. Leg Length: 1-1/2 inch.
- f. Mounting: Double-faced self-adhesive tape and fasteners.
- g. Location: 8 locations TBD on site

2.4 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Trim:
 - 1. Material: Aluminum.
 - 2. Manufacturer: Schluter.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work, including location of blocking.

3.2 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B. Install components plumb, level, square, and in proper alignment with drawings.

3.4 ADJUSTING

- A. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

3.5 CLEANING

- A. Dispose of all waste material in accordance with project's Waste Management Plan.

1. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.6 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Toilet Room Accessories.

1.2 RELATED REQUIREMENTS

- A . 016000 - Product Requirements: For substitution and additional product requirements.
- B. 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.3 SUBMITTALS

- A . Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.
- B . Sample: Submit 1 sample of each accessory, illustrating color and finish.
- C. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- D . Maintenance Data: For user's operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 MAINTENANCE MATERIAL

- A . Keys: Provide 2 keys for accessories to Owner; master key all lockable accessories.

1.5 QUALITY ASSURANCE

- A . Manufacturer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Accessories to be installed in toilet rooms.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A . Comply with ANSI/ICC A117.1, Americans with Disabilities Act (ADA Standards).

- B . Grab bars, shower seats, and dressing room benches shall be designed to resist a single concentrated load of 250 pounds applied in any direction, at any point on the grab bar or seat so as to produce the maximum loading effects, in accordance with ICC (IBC)-2018 Section 1607.8.2.
- C . Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

2.3 MANUFACTURERS

- A . Specification is based on Bobrick TrimLine Series.
 - 1. Substitutions for products by manufacturers other than those listed above: See Section 016000 - Product Requirements.
- B . Hand Dryer to be Dyson Air Blade

2.4 MATERIALS

- A . Stainless Steel Sheet:
 - 1. ASTM A666, Type 304.
- B . Stainless Steel Tubing:
 - 1. ASTM A269/A269M, Type 304 or 316.
- C . Back paint, in accordance with Section 099000 - Painting and Coating, where contact is made with building finishes to prevent electrolysis.
- D . Fasteners, Screws, and Bolts:
 - 1. Hot dip galvanized, tamper-proof, security type.
- E . Expansion Shields:
 - 1. Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.4 TOILET ROOM PRODUCTS

- A. Basis of Design: Bobrick TrimLine Series
 - 1. Grab bars.
 - 2. Surface Mount Seat cover dispensers.
 - 3. B35139 surface mount sanitary napkin disposals.
 - 4. Recessed toilet paper dispensers B35883.
 - 5. Recessed Soap dispensers B306 .
 - 6. Mobile device holder with bag hook.
- B. (LVG-1) Lavatory Guards:
 - 1. Product: Lav Guard 2 E-Z manufactured by Truebro, Inc.: www.truebro.com.
 - 2. Antimicrobial (ASTM G21 and G22 0 growth) molded closed cell vinyl covers; 1/8" nominal wall thickness; 70-80 Shore A, Finish: smooth, high gloss, UV resistant, paintable.
- C. Hand Dryer
 - 1. Dyson Airblade V Automatic Hand Dryer

2.2 ACCESSORIES

- A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A . General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B . Install plumb and level, securely and rigidly anchored to substrate.
- C . Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings.

3.4 TOLERANCES

- A . Maximum Variation From True Position: 1/4 inch.
- B . Maximum Variation From Plumb: 1/8 inch.

3.5 ADJUSTING

- A . Adjust and lubricate hardware for proper operation.

3.6 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.7 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Fire extinguishers.
- B . Fire extinguisher cabinets.

1.2 RELATED REQUIREMENTS

- A . 016000 - Product Requirements: For substitution and additional product requirements.
- B . 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C . 092116 - Gypsum Board Assemblies: Roughed-in wall openings and blocking.

1.3 SUBMITTALS

- A . Qualification Data: For manufacturer.
- B . Product Data: Provide extinguisher operational features, color and finish, and anchorage details.
- C . Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, wall bracket mounted measurements, and location.
- D . Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- E . Maintenance Data: For user's operation and maintenance of system including:
 - 1. Test, refill or recharge schedules and re-certification requirements.
 - 2. Methods for maintaining system's materials and finishes.
 - 3. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.4 QUALITY ASSURANCE

- A . Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A . Fire extinguishers and cabinets with accessories for proper use.

2.2 PERFORMANCE AND DESIGN CRITERIA

A . Portable fire extinguishers shall be selected and installed in accordance with this section and NFPA 10.

1. 2012 IBC.906.2.

2.3 MATERIALS

A . Fire Extinguishers:

1. Multi-Purpose Dry Chemical Extinguisher:

a. Specification is based on MP Series by Larsen's Manufacturing Co.

1) Comparable products by one of the following are also acceptable. See Section 016000 - Product Requirements for submittal requirements.

a) JL Industries, Inc: www.jlindustries.com.

b) Ansul, Inc: www.ansul.com.

2) Substitutions for products by manufacturers other than those listed above: See Section 016000 - Product Requirements.

b. Performance Criteria:

1) Complying with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

2) Labeled by UL for the purpose specified and indicated.

3) Class: A:B:C.

4) UL Rating: 4A-80B:C.

5) Extinguisher Model: Larsen's #MP10.

6) Size: 10 pound.

c. Features:

1) Finish: Baked polyester powder coat.

2) Color: Red.

3) Location: Per Architectural plans.

B . Fire extinguisher cabinets:

1. Fully recessed cabinets:

a. Specification is based on Ridge Series Cabinet by Nystrom.

1) Comparable products by one of the following are also acceptable. See Section 016000 - Product Requirements for submittal requirements.

a) Larsen's Manufacturing Co.

b) JL Industries, Inc: www.jlindustries.com.

- c) Ansul, Inc: www.ansul.com.
- 2) Substitutions for products by manufacturers other than those listed above:
See Section 016000 - Product Requirements.
- b. Performance Criteria:
 - 1) Sized to fit specified fire extinguisher.
 - 2) Provide Flame Shield option to maintain fire rating of assembly.
- c. Features:
 - 1) Fully recessed
 - 2) Door and Trim Material: Cold steel sheet with recoat able white polyester finish.
 - 3) Door Style: Flat with vertical lite
 - 4) Trim Style: Flat with square corners.
 - 5) Glazing: Clear Acrylic.
 - 6) Finish of Cabinet Exterior Trim and Door: White.

2.4 ACCESSORIES

- A . All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B . Manufacturer's accessories required by the project:
 - 1. Extinguisher Brackets: Formed steel, galvanized and enamel finished.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

- A . Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A . General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 ADJUSTING

- A . Adjust and lubricate hardware for proper operation.

3.5 CLEANING

- A . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.6 PROTECTION

- A . Protect installed work as required by the manufacturer to maintain product performance, design criteria, and warranty.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A . Metal lockers.

1.2 RELATED REQUIREMENTS

- A . 013000 - Administrative Requirements: For additional requirements of preinstallation meeting.
- B . 016000 - Product Requirements: For substitution and additional product requirements.
- C . 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- D . 092219 - Non-Structural Metal Framing: Blocking and nailers.

1.3 ADMINISTRATIVE REQUIREMENTS

- A . Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 013000 - Administrative Requirements.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 SUBMITTALS

- A . Product Data: Provide data on locker types, sizes, and accessories.
- B . Shop Drawings: Indicate locker plan layout, numbering plan.
- C . Samples: Submit two samples 3 x 6 inches in size, of each color scheduled; applied to specified substrate.
- D . Manufacturer's Installation Instructions: Indicate component installation assembly.

1.5 DELIVERY, STORAGE, AND HANDLING

- A . Protect locker finish and adjacent surfaces from damage.
- B . As required by SMACNA Guideline Chapter 3

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A . Metal lockers

2.2 PERFORMANCE AND DESIGN CRITERIA

A . Code required criteria.

1. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

2.3 METAL LOCKERS

A . Lockers: Heavy Duty, Factory assembled, made of formed sheet steel, ASTM A653/A653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; metal edges finished smooth without burrs; baked enamel finished inside and out.

1. Color: Color to be selected by Architect from standards.

B . Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.

1. Body and Shelves: 24 gage, 0.0239 inch.

C . Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.

1. Door Frame: 16 gage, 0.0598 inch, minimum.

D . Doors: Hollow double pan, sandwich construction, 1-3/16 inch thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.

1. Door Outer Face: 18 gage, 0.0478 inch, minimum.
2. Door Inner Face: 20 gage, 0.0359 inch, minimum.
3. Form recess for operating handle and locking device.
4. Provide louvers in door face, top and bottom, for ventilation.

E . Hinges: Two for doors under 42 inches high; three for doors over 42 inches high; weld securely to locker body and door.

1. Hinge Thickness: 14 gage, 0.0747 inc

F . Coat Hooks: Stainless steel or zinc-plated steel.

G . Number Plates: Provide oval shaped plates. Form 1.5 inch high of block font style with ADA designation, in contrasting color.

H . Fabricate accessible lockers with bottom shelf no lower than 15 inches above the floor. Place hooks, coat rods, and any additional shelves no higher than 48 inches above the floor.

I . Locking device: Padlock style.

2.4 METAL LOCKER UNITS

A . Width: 12 inches.

B . Depth: 18 inches.

C . Height: 72 inches.

D . Configuration: Varies; per plans

- E . Mounting: Per Plans
- F . Base: Metal base.
 - 1. Base Height: 4 inch.
- G . Top: Sloped metal with closures.
- H . Locking: Equipped for padlock hasps.
- I . Latching/Locking: Lift trigger of 14 gage steel with padlock eye.
- J . Ventilation Method: Door louvers
- K . Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
- L . Doors: Hollow channel edge construction, 1-3/16 inch thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.
- M . Hinges: Two for doors under 42 inches high; three for doors over 42 inches high; attached securely to locker body and door.
- N . Provide rubber silencer(s) at latch and door.
- O . Locking device supplied by Owner.
- P . Number Plates: Provide oval shaped aluminum plates. Form numbers approximately 1/2 inch high of block font style with ADA designation, in contrasting color.
- Q . Provide ventilation openings at top and bottom of each locker.
- R . Form recess for operating handle and locking device.
- S . Finish edges smooth without burrs.
- T . Fabricate tops, ends and closure pieces to match door finish.
- U . Latch function:
 - 1. Latch engage the frame at a minimum of three points on doors greater than 42 inches, two points at any door equal to or less than 42 inches. Locking device function "positive automatic type" where by the door may be locked when open and closed without unlocking.

PART 3 - EXECUTION

3.1 EXAMINATION

- A . Verify that prepared bases are in correct position and configuration.
- B . Verify bases and embedded anchors are properly sized.

3.2 INSTALLATION

- A . Install in accordance with manufacturer's instructions.

- B . Install lockers plumb and square.
- C . Place and secure on prepared base.
- D . Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.
- E . Bolt adjoining locker units together to provide rigid installation.
- F . Install end panels and filler panels.
- G . Install accessories.
- H . Replace components that do not operate smoothly.

3.3 CLEANING

- A . Clean locker interiors and exterior surfaces.
- B . Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.4 SCHEDULE

- A . TTK Metal Lockers without Legs, 12" Deep:
 - 1. Manufacturer: Tennsco.
 - 2. Application: 72" high heavy-duty metal lockers, single or multi tier locker without legs.
 - 3. Finish: Painted, manufacturer standard color.
 - 4. Location: See plans: staff room

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Marker Boards
- B. Tack Board

1.2 RELATED REQUIREMENTS

- A. 01 60 00 - Product Requirements: For substitution and additional product requirements.
- B. 01 74 21 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C. 06 10 00 – Rough Carpentry for backing and blocking required.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's printed product literature for each type of specialty, indicating colors, locations, overall dimensions.
- B. Samples: Submit sample of finish options for verification.
- C. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Interior Specialties: Miscellaneous specialties on building interior.

2.2 PERFORMANCE AND DESIGN CRITERIA

- A. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.3 MATERIALS

- A. Marker Boards:
 - 1. Basis of Design: Claridge magnetic glass board.

a. Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 - Product Requirements.

2. Material: Nonglare magnetic glass.
3. Size: 4' x 8'.
4. Mounting: Concealed (Invisi-mount).
5. Accessories: Aluminum marker tray, manufacturer's standard extruded profile, one piece full length of board, molded ends, concealed fasteners, satin finish; (2) sets of magnets.
6. Color and Finish: Architect to select from manufacturer's full range.

B. Tack Boards:

1. Basis of Design: Composition Cork by Forbo Bulletin Board.
 - a. Comparable products by one of the following are also acceptable. See Section 01 60 00 - Product Requirements for submittal requirements.
 - b. Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 - Product Requirements.
2. Material: Composition cork: ground cork and linoleum.
3. Size: As indicated on Drawings.
4. Cork Thickness: 1/4 inch.
5. Backing Fabric: Jute.
6. Mounting: 1" VELCRO® brand tape or screws.
7. Accessories: Provide 5/4 MDF frame, painted.
8. Color and Finish: Architect to select from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.

- C. Protect from damage until Substantial Completion; repair or replace damage items.

3.3 CLEANING

- A. Dispose of all waste material in accordance with project's Waste Management Plan.
 - 1. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section includes manually operated window roller shades.

1.2 RELATED REQUIREMENTS

- A. 01 60 00 - Product Requirements: For substitution and additional product requirements.
- B. 01 74 21 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- C. Floor plan for locations and dimensions.

1.3 ADMINISTRATIVE REQUIREMENTS

1.4 SUBMITTALS

- A. Qualification Data: For installer.
- B. Product Data: For each type of product.
 - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- C. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
 - 1. Show guides, enclosures, and accessories as proposed to be installed in each location.
 - 2. Provide accurate to 0.0625 inch; field measurements for custom shade fabrication on the Roller Shades manufacturers input forms.
- D. Samples: For each exposed product and for each color and texture specified.
- E. Roller-Shade Schedule: Use same designations indicated on Drawings.
- F. Product certificates.
- G. Product test reports.
- H. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.6 COORDINATION

- A. Attend Pre-Con meeting as well as any subcontractor meetings required to coordinate the work.
- B. The WC shall participate and cooperate with the electrical contractor, the window shade manufacturer and the Commissioning agent to verify and certify the installation is in full conformance with the specifications and is fully operational. This work to occur during the commissioning stage and is in addition to preliminary acceptance required for each floor.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
- B. As required by SMACNA Guideline Chapter 3

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Manually-operated roller shades with capability for single shade cloth.

2.3 MANUFACTURERS

- A. Window Shade: Basis-of-Design: Subject to compliance with requirements, provide products from MechoShade Systems, Inc. or comparable product by one of the following:
 - 1. Draper
 - 2. Nysan Solar Control Inc.; Hunter Douglas Company.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.4 WINDOW ROLLER SHADES

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop metal bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated. Provide chain clips to secure bottom of loop to adjacent surface.
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - 1. Roller Mounting Configuration: Single roller and Double roller, offset with outside over the inside.
 - 2. Roller Drive-End Location: As indicated.
 - 3. Direction of Shadeband Roll: Regular, from back of roller.
 - 4. Shadeband-to-Roller Attachment: Manufacturer's standard method.

- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. 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.
- E. Shade Cloth:
 - 1. Shade Cloth Material: BOD EcoVeil, 1% Open
 - 2. Shade Cloth Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Single Shade Opacity: Blackout
 - b. Type: Enclosed in sealed pocket of shadeband material.
 - c. Color and Finish: As selected by Architect from manufacturer's full range.
- F. Installation Accessories:
 - 1. Provide manufacturer's sheet metal valence, and accessories, color to be selected from manufacturer's standard colors.
 - 2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
 - a. Closure-Panel Width: As indicated on Drawings.
 - 3. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
 - 4. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
 - 5. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.5 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-filtering Fabric: Woven Fabric, stain and fade resistant.
 - 1. As Specified in Finish Legend.

2.6 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).

2.7 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Conduct field inspection on an area-by area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop drawings.
- C. Verifications of conditions: Examine the areas to receive the work and conditions under which the work would be performed and notify General Contractor and Owner of conditions detrimental to the proper and timely completion of the work.
- D. Do not proceed until unsatisfactory conditions have been corrected in that area.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units, according to manufacturer's written instructions.
 - 1. Shadebands: Located so shadeband is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Install roller shades and set intermediate stops of all shades to assure the alignment of the shade bands within a single group.
 - 1. Tolerance: Maximum Variation from alignment shall not exceed +/- 0.125 inches.
- C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- D. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

3.3 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.4 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.
- B. Adjust, align and balance roller shades to operate smoothly, easily, safely and free from binding or malfunction throughout entire operational range.
- C. Installer shall set Upper, Lower, and up to 3 intermediate stop positions of all motorized shade bands, and assure alignment in accordance with the above requirements.
- D. Certify the operation of all motorized shades and turn over each floor for preliminary acceptance.

3.5 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.
- C. Dispose of all waste material in accordance with project's Waste Management Plan.
 - 1. See Section 01 74 21 - Construction Waste Management and Disposal for additional requirements.

END OF SECTION

SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber or NBR 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.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Presealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, 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 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. 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 for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position water stop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.
 2. Exterior Concrete Walls below Grade:

- a. Piping Smaller Than NPS 6: Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or Stack-sleeve fittings.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or Stack-sleeve fittings.
5. Interior Partitions:
- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - 2. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

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END OF SECTION 220518

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 Specification Sections, 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. Bronze gate valves.
 - 6. Bronze globe valves.
 - 7. Lubricated plug valves.
 - 8. Chainwheels.
- B. Related Sections:
 - 1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
 - 3. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this 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. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION 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. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
 - 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. Hammond Valve.
 - b. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. NIBCO INC.

2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Class 150, Bronze Angle Valves with Bronze Disc:
 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. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kitz Corporation.
 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.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- D. Class 150, Bronze Angle Valves with Nonmetallic Disc:
 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. 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: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRONZE BALL VALVES

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

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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.4 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

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. Flo Fab Inc.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. Mueller Steam Specialty; a division of SPX Corporation.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.5 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.
- C. Class 150, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Zy-Tech Global Industries, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.

- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.6 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, RS Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.

- f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Class 150, NRS Bronze Gate Valves:
 - 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. Hammond Valve.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Powell Valves.
 - f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 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.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- D. Class 150, RS Bronze Gate Valves:
 - 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.

- g. Powell Valves.
- h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- i. Zy-Tech Global Industries, Inc.
- 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: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.7 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

- 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

- 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.

2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

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

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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. Zy-Tech Global Industries, Inc.
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: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.8 LUBRICATED PLUG VALVES

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

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. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.

- e. Plug: Cast iron or bronze with sealant groove.
- B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
- 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. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.
- C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:
- 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. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.
- D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:
- 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. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.
- E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

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. Nordstrom Valves, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.
- F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
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. Nordstrom Valves, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.
- G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:
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. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.
- H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:
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. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.

2.9 CHAINWHEELS

- 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. Babbitt Steam Specialty Co.
 2. Roto Hammer Industries.
 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to ball butterfly and plug valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine 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 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, gate, or plug valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Globe, ball, or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze 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, resilient-seat check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: Two piece, full port, bronze with bronze trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, NRS or RS.
6. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.
4. Iron Swing Check Valves: Class 125 nonmetallic-to-metal seats.
5. Iron Swing Check Valves with Closure Control: Class 125, lever and spring or weight.
6. Iron Gate Valves: Class 125, NRS or OS&Y.
7. Iron Globe Valves: Class 125.

END OF SECTION 220523

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

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

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.

- f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
- 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 3. Standard: MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturned lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
 - 7. Metallic Coating: Electroplated zinc.
 - 8. Paint Coating: Epoxy.
- B. Non-MFMA Manufacturer Metal Framing Systems:
- 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. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturned lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 - 7. Coating: Zinc or Paint.

2.4 THERMAL-HANGER SHIELD INSERTS

- 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. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.

6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: 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.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Base: Plastic.

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:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
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 supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-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 INSTALLATION

- A. Metal 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 the building structure.
- B. Metal 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 for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- 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-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, 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 that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- O. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. **NPS 1/4 to NPS 3-1/2: 12 inches** long and **0.048 inch** thick.
 - b. **NPS 4: 12 inches** long and **0.06 inch** thick.
 - c. **NPS 5 and NPS 6: 18 inches** long and **0.06 inch** thick.
 - d. **NPS 8 to NPS 14: 24 inches** long and **0.075 inch** thick.
 - e. **NPS 16 to NPS 24: 24 inches** long and **0.105 inch** thick.

5. Pipes **NPS 8** and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

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

3.4 ADJUSTING

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

3.5 PAINTING

- A. 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 a minimum dry film thickness of **2.0 mils**.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to **1050 deg F**, pipes **NPS 4 to NPS 24**, requiring up to **4 inches** of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36**, requiring clamp flexibility and up to **4 inches** of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24** if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4**, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8**.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8**.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3**.
 12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30**.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30**, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24**, from single rod if horizontal movement caused by expansion and contraction 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.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24**.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24** if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to **6 inches** for heavy loads.
 2. Steel Clevises (MSS Type 14): For **120 to 450 deg F** piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For **120 to 450 deg F** piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): **750 lb.**
 - b. Medium (MSS Type 32): **1500 lb.**
 - c. Heavy (MSS Type 33): **3000 lb.**
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. 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 allow 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 allow 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 allow 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.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION 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. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.
- 2.2 WARNING SIGNS AND LABELS
- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - B. Letter Color: White.
 - C. Background Color: Red.
 - D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

- F. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with **1/4-inch** letters for piping system abbreviation and **1/2-inch** numbers.
 - 1. Tag Material: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on **8-1/2-by-11-inch** bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

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: Approximately 4 by 7 inches.
 - 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 1. Domestic Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

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; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches, round.
 - b. Hot Water: 2 inches, round.
2. Valve-Tag Color:
 - a. Cold Water: Natural or Green.
 - b. Hot Water: Natural or Green.
3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Above grade storm drainage piping.
 - 5. Above grade waste piping
 - 6. Supplies and drains for handicap-accessible lavatories and sinks.

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 application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation

materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- 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.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

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 "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come 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. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 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. Pittsburgh Corning Corporation; Foamglas.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 - 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
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. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- I. Mineral-Fiber, Preformed Pipe Insulation:
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. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 Deg F Materials: Mineral or 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.
- J. Phenolic:
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. Kingspan Tarec Industrial Insulation NV; Koolphen K.
 - b. Resolco International BV; Insul-phen.
 2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 5. Factory-Applied Jacket: ASJ. Requirements are specified in "Factory-Applied Jackets" Article.
- K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.
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. Armacell LLC; Tubolit.
- b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 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. Ramco Insulation, Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 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. Ramco Insulation, Inc.; Thermokote V.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 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. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 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. Aeroflex USA, Inc.; Aeroseal.

- b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 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-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 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. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
- 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-96.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.
 - 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."
- F. 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, 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-82.

- b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 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."
- G. PVC Jacket Adhesive: Compatible with PVC 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. 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."

2.4 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, available products that may be incorporated into the Work include, but are not limited to, 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, 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-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, 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; 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, 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-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.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. 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, 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-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Phenolic 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.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
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. FSK and Metal 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.
 - b. Eagle Bridges - Marathon Industries; 405.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. 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."
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and 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."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM 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.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
 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; Chil-Glas Number 10.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
 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. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
 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. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 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.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
 1. Products: Subject to compliance with requirements, 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: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
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: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

- 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard Products, Inc.; Insulrap No Torch 125.

2.11 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.

2.12 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 and Seals.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.
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.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

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. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. Zurn Industries, LLC; 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.

B. Protective Shielding Piping Enclosures,:

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. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 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 pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 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. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at valves, unions, and equipment requiring removal of insulation for maintenance. 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 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of 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 services, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe 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. Secure according to manufacturer's written instructions.
 - 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of cellular-glass insulation to valve body.
 - 2. 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.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

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

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as 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.

3.9 INSTALLATION OF PHENOLIC INSULATION

- A. General Installation Requirements:
1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
- B. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of 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 services, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- C. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
- D. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

- E. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
 - 2. 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.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Seal split-tube 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 polyolefin 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 polyolefin 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 cut sections of polyolefin pipe and sheet insulation to valve body.
 - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.

- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. 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.

3.12 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers,

two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 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.

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-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. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Domestic Chilled Water (Potable):
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- E. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

- F. Exposed Waste Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- G. 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. Protective Shielding Guard.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
- D. Piping, Exposed:
 - 1. PVC: 20 mils thick.

END OF SECTION 22 07 19

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
 - 2. Encasement for piping.
- B. Related Requirements:

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: **ASTM B 88, Type L** and **ASTM B 88, Type M** water tube, drawn temper.
- B. Soft Copper Tube: **ASTM B 88, Type K** and **ASTM B 88, Type L** water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:
 - 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. Elkhart Products Corporation.
 - b. NIBCO Inc.
 - c. Viega.
 - 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
 - 3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- H. Copper Push-on-Joint Fittings:

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. Victaulic Company.
 - b. Mueller.
 - c. Elkhart
2. Description:
 - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
 - b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

I. Copper-Tube, Extruded-Tee Connections:

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. T-Drill Industries Inc.
2. Description: Tee formed in copper tube according to ASTM F 2104.

J. Appurtenances for Grooved-End Copper Tubing:

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. Anvil International.
 - b. Shurjoint Piping Products.
 - c. Victaulic Company.
2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
3. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: **300 psig.**

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
 1. AWWA C110/A21.10, ductile or gray iron.
 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
 1. AWWA C153/A21.53, ductile iron.
 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Push-on-Joint, Ductile-Iron Pipe:
 1. AWWA C151/A21.51.
 2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
- E. Standard-Pattern, Push-on-Joint Fittings:
 1. AWWA C110/A21.10, ductile or gray iron.
 2. Gaskets: AWWA C111/A21.11, rubber.
- F. Compact-Pattern, Push-on-Joint Fittings:
 1. AWWA C153/A21.53, ductile iron.
 2. Gaskets: AWWA C111/A21.11, rubber.
- G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.
- H. Appurtenances for Grooved-End, Ductile-Iron Pipe:
 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. Shurjoint Piping Products.
 - b. Star Pipe Products.
 - c. Victaulic Company.
 2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.
 3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
 - a. AWWA C606 for ductile-iron-pipe dimensions.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.

- e. Minimum Pressure Rating:
 - 1) NPS 14 to NPS 18: 250 psig.
 - 2) NPS 20 to NPS 46: 150 psig.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe:

- 1. ASTM A 53/A 53M, Type E, Grade B, Standard Weight.
- 2. Include ends matching joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:

- 1. ASME B16.39, Class 150.
- 2. Hexagonal-stock body.
- 3. Ball-and-socket, metal-to-metal, bronze seating surface.
- 4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:

- 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. Anvil International.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
- 2. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
- 3. Fittings for Grooved-End, Galvanized-Steel Pipe:
 - a. AWWA C606 for steel-pipe dimensions.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating:
 - 1) NPS 8 and Smaller: 600 psig.

- 2) NPS 10 and NPS 12: 400 psig.
- 3) NPS 14 to NPS 24: 250 psig.

2.5 STAINLESS-STEEL PIPING

- A. Potable-water piping and components shall comply with NSF 61.
- B. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 10 and Schedule 40.
- C. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.
- D. Appurtenances for Grooved-End, Stainless-Steel Pipe:
 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. Anvil International.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
 2. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.
 3. Mechanical Couplings for Grooved-End, Stainless-Steel Pipe:
 - a. AWWA C606 for stainless-steel-pipe dimensions.
 - b. Stainless-steel housing sections.
 - c. Stainless-steel bolts and nuts.
 - d. EPDM-rubber gaskets suitable for hot and cold water.
 - e. Minimum Pressure Rating:
 - 1) NPS 8 and Smaller: 600 psig.
 - 2) NPS 10 and NPS 12: 400 psig.
 - 3) NPS 14 to NPS 24: 250 psig.

2.6 CPVC PIPING

- A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40 and Schedule 80.
 1. CPVC Socket Fittings: ASTM F 438 for Schedule 40 and ASTM F 439 for Schedule 80.
 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
- B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
- C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.7 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
- B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

2.8 PEX-AL-PEX TUBE AND FITTINGS

- A. PEX-AL-PEX Distribution System: ASTM F 1281 tubing.
- B. Fittings for PEX-AL-PEX Tube: ASTM F 1281, metal-insert type with copper or stainless-steel crimp rings and matching PEX-AL-PEX tube dimensions.

2.9 PEX-AL-HDPE TUBE AND FITTINGS

- A. PEX-AL-HPDE Distribution System: ASTM F 1986 tubing.
- B. Fittings for PEX-AL-HDPE Tube: ASTM F 1986, metal-insert type with copper or stainless-steel crimp ring and matching PEX-AL-HDPE tube dimensions

2.10 PVC PIPE AND FITTINGS

- A. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.
- B. PVC Socket Fittings: ASTM D 2466 for Schedule 40 and ASTM D 2467 for Schedule 80.
- C. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.11 PP PIPE AND FITTINGS

- A. PP Pipe: ASTM F 2389, SDR 7.4 and SDR 11.
- B. PVC Socket Fittings: ASTM F 2389.

2.12 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.

2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Solvent cement and adhesive primer 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."
- G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Solvent cement and adhesive primer 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."
- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.13 ENCASUREMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

2.14 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

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. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
2. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

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. Colonial Engineering, Inc.
 - b. NIBCO Inc.
 - c. Spears Manufacturing Company.

2. Description:
 - a. CPVC or PVC four-part union.
 - b. Brass threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.15 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International.
 - e. Matco-Norca.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 2. Standard: ASSE 1079.
 3. Pressure Rating: 125 psig minimum at 180 deg F.
 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 2. Standard: ASSE 1079.
 3. Factory-fabricated, bolted, companion-flange assembly.
 4. Pressure Rating: 125 psig minimum at 180 deg F.
 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "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 and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- H. Install domestic water piping level without pitch and plumb.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install PEX piping with loop at each change of direction of more than 90 degrees.

- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

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. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Square cut or Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- M. Joint Construction for Solvent-Cemented Plastic Piping: 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. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D 2855.
- N. Joints for PEX Piping: Join according to ASTM F 1807.
- O. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping **NPS 2** and Smaller: Plastic-to-metal transition fittings or unions.

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 nipples.
- C. Dielectric Fittings for **NPS 2-1/2 to NPS 4**: Use dielectric flanges, flange kits, or nipples.
- D. Dielectric Fittings for **NPS 5** and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Vertical Piping: MSS Type 8 or 42, clamps.
 2. Individual, Straight, Horizontal Piping Runs:
 - a. **100 Feet** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than **100 Feet**: MSS Type 43, adjustable roller hangers.
 - c. Longer Than **100 Feet** if Indicated: MSS Type 49, spring cushion rolls.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of **3/8 inch**.
- E. 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.
- F. Install supports for vertical copper tubing every **10 feet**.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every **15 feet**.
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- J. Install supports for vertical stainless-steel piping every **15 feet**.
- K. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
 3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 5. NPS 6: 48 inches with 3/4-inch rod.
 6. NPS 8: 48 inches with 7/8-inch rod.
- L. Install supports for vertical CPVC piping every **60 inches** for **NPS 1** and smaller, and every **72 inches** for **NPS 1-1/4** and larger.
- M. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.
- N. Install hangers for vertical PEX piping every 48 inches.
- O. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
 2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 4. NPS 6: 48 inches with 3/4-inch rod.
 5. NPS 8: 48 inches with 7/8-inch rod.
- P. Install supports for vertical PVC piping every 48 inches.
- Q. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
 3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 5. NPS 6: 48 inches with 3/4-inch rod.
 6. NPS 8: 48 inches with 7/8-inch rod.
- R. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- S. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate

test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
- 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, **NPS 3** and smaller, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water piping, **NPS 2** and smaller, shall be the following:
 - 1. Hard or soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- F. Aboveground domestic water piping, **NPS 2** and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. PEX tube, NPS 1 and smaller; fittings for PEX tube; and crimped joints.
 - 3. PE-AL-PE tube, NPS 1 and smaller; fittings for PE-AL-PE tube; and crimped joints

4. PEX-AL-PEX tube, NPS 1 and smaller; fittings for PEX-AL-PEX tube; and crimped joints.
- G. Aboveground domestic water piping, **NPS 2-1/2 to NPS 4**, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

3.13 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 balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 11 16

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
 - 2. Waste, Force-Main Piping: 100 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. CISPI, Hubless-Piping Couplings:

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. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

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. MG Piping Products Company.
2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Steel Pipe Pressure Fittings:
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - 3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 - 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. Anvil International; a subsidiary of Mueller Water Products, Inc.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
 - 2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
 - 3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.5 STAINLESS-STEEL PIPE AND FITTINGS

- A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.
- B. Internal Sealing Rings: Elastomeric gaskets shaped to fit socket groove.

2.6 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Gaskets: AWWA C111/A21.11, rubber.

C. Ductile-Iron, Grooved-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
2. Ductile-Iron-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Star Pipe Products.
 - 4) Victaulic Company.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
 - c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.7 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- E. Copper Pressure Fittings:
 - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.8 ABS PIPE AND FITTINGS

- A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- D. Solvent Cement: ASTM D 2235.
 - 1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Solvent cement 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."

2.9 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer 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. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement 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."

2.10 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - 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) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

- 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) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
- b. Standard: ASTM C 1460.
- c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:

- 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) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) JCM Industries, Inc.
 - 5) Romac Industries, Inc.
 - 6) Smith-Blair, Inc.; a Sensus company.
 - 7) The Ford Meter Box Company, Inc.
 - 8) Viking Johnson.
- b. Standard: AWWA C219.
- c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: Manufacturer's standard.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
 - a. 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) Capitol Manufacturing Company.

- 2) Central Plastics Company.
- 3) Hart Industries International, Inc.
- 4) Jomar International Ltd.
- 5) Matco-Norca, Inc.
- 6) McDonald, A. Y. Mfg. Co.
- 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 8) Wilkins; a Zurn company.

b. Description:

- 1) Standard: ASSE 1079.
- 2) Pressure Rating: 125 psig minimum at 180 deg F.
- 3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

- 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) Capitol Manufacturing Company.
- 2) Central Plastics Company.
- 3) Matco-Norca, Inc.
- 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 5) Wilkins; a Zurn company.

b. Description:

- 1) Standard: ASSE 1079.
- 2) Factory-fabricated, bolted, companion-flange assembly.
- 3) Pressure Rating: 125 psig minimum at 180 deg F.
- 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Advance Products & Systems, Inc.
- 2) Calpico, Inc.
- 3) Central Plastics Company.
- 4) Pipeline Seal and Insulator, Inc.

b. Description:

- 1) Nonconducting materials for field assembly of companion flanges.

- 2) Pressure Rating: 150 psig.
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

- 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) Elster Perfection.
- 2) Grinnell Mechanical Products.
- 3) Matco-Norca, Inc.
- 4) Precision Plumbing Products, Inc.
- 5) Victaulic Company.

- b. Description:

- 1) Standard: IAPMO PS 66
- 2) Electroplated steel nipple.
- 3) Pressure Rating: 300 psig at 225 deg F.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.11 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. 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.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. 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 two 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.
- L. 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.
- M. 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; 2 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.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Install steel piping according to applicable plumbing code.
- P. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.
- Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- R. Install aboveground ABS piping according to ASTM D 2661.
- S. Install aboveground PVC piping according to ASTM D 2665.
- T. Install underground ABS and PVC piping according to ASTM D 2321.
- U. Install engineered soil and waste drainage and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- V. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- W. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- X. Install force mains at elevations indicated.
- Y. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- Z. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- AA. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- BB. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- CC. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. 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. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

- G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.
 - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.
 - 4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
 - 1. Install shutoff valve on each sewage pump discharge.
 - 2. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 3. Install gate valve for piping NPS 2-1/2 and larger.

- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
 8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2: 84 inches with 3/8-inch rod.
 2. NPS 3: 96 inches with 1/2-inch rod.
 3. NPS 4: 108 inches with 1/2-inch rod.
 4. NPS 6: 10 feet with 5/8-inch rod.
- K. Install supports for vertical stainless-steel piping every 10 feet.
- L. 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 and 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.
- M. Install supports for vertical copper tubing every 10 feet.
- N. Install hangers for ABS and 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 NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

- O. Install supports for vertical ABS and PVC piping every 48 inches.
- P. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect 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. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves with cleanout cover flush with floor.
 6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 7. 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.
- D. Connect force-main piping to the following:
 1. Sanitary Sewer: To exterior force main.
 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary 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.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings and solvent stack fittings; heavy-duty hubless-piping couplings; and coupled joints.
 3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. 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; heavy-duty hubless-piping couplings; and coupled joints.

3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Condensate Drain Piping:
1. Pipe material: Copper Type L or PVC.
 2. Joint type: Solder 95/5 and solvent.
 3. Fitting material: Wrought copper or PVC.

END OF SECTION 22 13 16

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cleanouts.
 - 2. 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. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product used. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that FOG disposal systems, grease interceptors, grease removal devices, oil interceptors, accessories, and components will withstand seismic forces defined in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete."

- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

- 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) Josam Company.
- 2) MIFAB, Inc.
- 3) Smith, Jay R. Mfg. Co.
- 4) Tyler Pipe.
- 5) Watts Drainage Products.
- 6) Zurn Plumbing Products Group.

2. ASME A112.3.1, Stainless-Steel Cleanouts:

- 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) Josam Company.

3. Standard: ASME A112.36.2M for cast iron, and ASME A112.3.1 for stainless steel for cleanout test tee.
4. Size: Same as connected drainage piping
5. Body Material: Hubless, cast-iron soil pipe test tee or Stainless-steel tee with side cleanout as required to match connected piping.
6. Closure: Countersunk or raised-head, brass plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Closure: Stainless-steel plug with seal.

- B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

- 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) Josam Company.

- 2) Oatey.
- 3) Sioux Chief Manufacturing Co., Inc.
- 4) Smith, Jay R. Mfg. Co.
- 5) Tyler Pipe.
- 6) Watts Drainage Products.
- 7) Zurn Plumbing Products Group.

2. ASME A112.36.2M, Stainless-Steel Cleanouts:

- 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) Josam Company.
- 2) Kusel Equipment Co.
- 3) Smith, Jay R. Mfg. Co.

3. ASME A112.3.1, Stainless-Steel Cleanouts:

- 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) Josam Company.

4. Standard: ASME A112.36.2M for adjustable housing cleanout.
5. Size: Same as connected branch.
6. Type: Adjustable housing.
7. Body or Ferrule: Cast iron.
8. Clamping Device: Not required.
9. Outlet Connection: Inside calk, Spigot, or Threaded.
10. Closure: Brass plug with tapered threads.
11. Adjustable Housing Material: Cast iron with threads.
12. Frame and Cover Material and Finish: Polished bronze.
13. Frame and Cover Shape: Round.
14. Top Loading Classification: Heavy Duty.
15. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
16. Standard: ASME A112.3.1.
17. Size: Same as connected branch.
18. Housing: Stainless steel.
19. Closure: Stainless steel with seal.
20. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

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. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
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 or raised-head, drilled-and-threaded 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 screw.
 8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Plastic Floor Cleanouts:

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. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
2. Size: Same as connected branch.
3. Body: PVC.
4. Closure Plug: PVC.
5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

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. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.

- f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Standard: ASME A112.6.3.
 - 3. Pattern: As scheduled.
 - 4. Body Material: Gray iron.
 - 5. Seepage Flange: Required.
 - 6. Anchor Flange: Required.
 - 7. Clamping Device: Required.
 - 8. Coating on Interior and Exposed Exterior Surfaces: As scheduled.
 - 9. Sediment Bucket: As scheduled.
 - 10. Top or Strainer Material: As Scheduled.
 - 11. Top of Body and Strainer Finish: As scheduled.
 - 12. Top Shape: Round or Square as scheduled.
 - 13. Top Loading Classification: Medium Duty unless noted otherwise.
 - 14. Funnel: As scheduled.
 - 15. Trap Features: Trap-seal primer valve drain connection.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

- 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. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- 2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

- 1. 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. 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.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch-minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

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.

2.7 MOTORS

- A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- 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. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- I. Assemble open drain fittings and install with top of hub 2 inches above floor.
- J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- N. Install vent caps on each vent pipe passing through roof.
- O. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- Q. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- R. Assemble components of FOG disposal systems and install on floor. Install trap, vent, fresh-air inlet, and flow-control fitting according to authorities having jurisdiction. Install shelf fastened to reinforcement in wall construction and adjacent to unit, unless otherwise indicated. Install culture bottle, culture metering pump, timer, and control on shelf. Install tubing between culture bottle, metering pump, and chamber.
- S. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.

- 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
- 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- T. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction. Install control panel adjacent to unit, unless otherwise indicated.
- U. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Section 231113 "Facility Fuel-Oil Piping."
- V. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- W. Install wood-blocking reinforcement for wall-mounting-type specialties.
- X. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. FOG Disposal Systems: Connect inlet and outlet to unit, connect flow-control fitting and fresh-air inlet piping to unit inlet piping, and connect vent piping between trap and media chamber. Connect electrical power.
- D. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- E. Grease Removal Devices: Connect controls, electrical power, factory-furnished accessories, and inlet, outlet, and vent piping to unit.
- F. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
- G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- H. Connect wiring according to Section 260519 "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 Section 076200 "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. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. FOG disposal systems.
 - 2. Grease interceptors.
 - 3. Grease removal devices.
 - 4. Oil interceptors.
 - 5. Solids interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to

identifying unit. Nameplates and signs are specified in Section 220553 "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 22 13 19

SECTION 22 42 13.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Water closets.
 - 2. Toilet seats.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flush valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

- A. Water Closets: Floor mounted, bottom outlet, top spud.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - a. Kohler Co.
 - 2. Bowl:

- a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
- b. Material: Vitreous china.
- c. Type: Siphon jet.
- d. Style: Flushometer valve.
- e. Height: Standard, Child, or Handicapped/elderly, complying with ICC/ANSI A117.1 as scheduled.
- f. Rim Contour: Elongated.
- g. Water Consumption: 1.28 gal. or 1.6 gal. per flush as scheduled.
- h. Spud Size and Location: NPS 1-1/2; top.
- i. Color: [White] <Insert color>.
3. Bowl-to-Drain Connecting Fitting: ASTM A 1045 or ASME A112.4.3.
4. Flushometer Valve: As scheduled.
5. Toilet Seat: As scheduled.

2.2 FLUSHOMETER VALVES

- A. Lever-Handle, Diaphragm Flushometer Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Gerber Plumbing Fixtures LLC.
 - b. Sloan Valve Company.
 - c. Zurn Industries, LLC; Commercial Brass and Fixtures.
 2. Standard: ASSE 1037.
 3. Minimum Pressure Rating: 125 psig.
 4. Features: Include integral check stop and backflow-prevention device.
 5. Material: Brass body with corrosion-resistant components.
 6. Exposed Flushometer-Valve Finish: Chrome plated.
 7. Style: Exposed.
 8. Consumption: 1.28 gal. or 1.6 gal. per flush as scheduled.
 9. Minimum Inlet: NPS 1.
 10. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

- A. Toilet Seats:
 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. Kohler Co.
 2. Standard: IAPMO/ANSI Z124.5.
 3. Material: Plastic.
 4. Type: Commercial (Standard).

5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Water-Closet Installation:
 1. Install level and plumb according to roughing-in drawings.
 2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
- B. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- C. Install toilet seats on water closets.
- D. Joint Sealing:
 1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
 2. Match sealant color to water-closet color.
 3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 22 42 16.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Lavatories.
- 2. Faucets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory: Oval, vitreous china, undercounter mounted or wall mounted.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - a. Kohler Co.
 - 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For undercounter mounting.
 - c. Nominal Size: Rectangular, 19 by 13 inches.
 - d. Faucet-Hole Punching: No holes.
 - e. Faucet-Hole Location: On countertop.
 - f. Color: White.
 - g. Mounting Material: Sealant and undercounter mounting kit.
 - 3. Faucet: As scheduled.

2.2 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Automatic-type, battery-powered, electronic-sensor-operated, mixing, solid-brass valve.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - a. Kohler Co.
 - 2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
 - 5. Body Type: Single hole.
 - 6. Body Material: General-duty, solid brass.
 - 7. Finish: Polished chrome plate.

8. Maximum Flow Rate: 0.5 gpm.
9. Mounting Type: Deck, concealed.
10. Spout: Rigid type.
11. Spout Outlet: Aerator.
12. Drain: Not part of faucet.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
 1. NPS 1/2.
 2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
 1. Size: NPS 1-1/2 by NPS 1-1/4.
 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 16.13

SECTION 22 42 16.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Service basins.
 - 2. Sink faucets.
 - 3. Supply fittings.
 - 4. Waste fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
 - 2. Include rated capacities, operating characteristics and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SINKS

- A. Sinks double and single bowl, counter mounted, stainless steel.
 - 1. Stainless-Steel Sinks:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - 1) Elkay Manufacturing Co.
 - 2. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel sinks.
 - b. Overall Dimensions: As scheduled.
 - c. Metal Thickness: 18 gauge.
 - d. Bowls:

- 1) Dimensions: As scheduled.
- 2) Drain: **3.5-inch**.
 - a) Location: Centered in bowl.
3. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
4. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multibowl sinks.

2.2 SERVICE BASINS

- A. Service Basins: Terrazzo, floor mounted.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - a. Elkay Manufacturing Co.
 2. Fixture:
 - a. Standard: IAPMO PS 99.
 - b. Shape: Square.
 - c. Nominal Size: **24 by 24 inches**.
 - d. Height: **10 inches**.
 - e. Tiling Flange: Not required.
 - f. Rim Guard: On front top surfaces.
 - g. Color: Not applicable.
 - h. Drain: Grid with **NPS 3** outlet.
 3. Mounting: On floor and flush to wall.

2.3 SINK FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: Manual type, two-lever-handle mixing valve.
 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. Delta Faucet Company.
 2. Standard: ASME A112.18.1/CSA B125.1.
 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punching; coordinate outlet with spout and sink receptor.
 4. Body Material: Commercial, solid brass.
 5. Finish: Polished chrome plate.

2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
 - 1. NPS 3/8
 - 2. Chrome-plated, soft-copper flexible tube.

2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2.
 - 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

2.6 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 16.16

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 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on 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. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 2200 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: 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.

2.4 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: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping 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: Plastic for medium under 100 deg. F or Stainless steel for temperatures above 100 deg. F.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Presealed Systems.

- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, 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 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. 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 for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:

- 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves or Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves or Galvanized-steel-pipe sleeves.
- 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron floor sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system, or Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron floor sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system, or Galvanized-steel-pipe sleeves.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves, Stack-sleeve fittings, or Sleeve-seal fittings.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or Stack-sleeve fittings.

5. Interior Partitions:

- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
- b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 23 05 17

SECTION 23 05 19 - METERS AND GAUGES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following meters and gages for mechanical systems:

1. Thermometers.
2. Gages.
3. Test plugs.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Operation and maintenance data.

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 THERMOMETERS

- A. Liquid-in-Glass Thermometers:
1. Manufacturers:
 - a. Ernst Gage Co.
 - b. Eugene Ernst Products Co.
 - c. Marsh Bellofram.
 - d. Miljoco Corp.
 - e. Trerice, H. O. Co.
 - f. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - g. Winters Instruments.
 2. Case: Plastic, 7 inches long.
 3. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.
 4. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 5. Window: Glass or plastic.
 6. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
 7. Stem: Metal, for thermowell installation and of length to suit installation.

8. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

B. Bimetallic-Actuated Dial Thermometers:

1. Manufacturers:
 - a. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - b. Ernst Gage Co.
 - c. Eugene Ernst Products Co.
 - d. Marsh Bellofram.
 - e. Miljoco Corp.
 - f. NANMAC Corporation.
 - g. Noshok, Inc.
 - h. Palmer - Wahl Instruments Inc.
 - i. REO TEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Weiss Instruments, Inc.
 - m. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - n. WIKA Instrument Corporation.
 - o. Winters Instruments.
2. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.
3. Case: Dry type, stainless steel with 3-inch diameter.
4. Element: Bimetal coil.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass or plastic.
8. Ring: Stainless steel.
9. Connector: Adjustable angle type.
10. Stem: Metal, for thermowell installation and of length to suit installation.
11. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

C. Thermowells:

1. Manufacturers: Same as manufacturer of thermometer being used.
 - a. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. KOBOLD Instruments, Inc.
6. Marsh Bellofram.

7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Metal.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.4 TEST PLUGS

A. Manufacturers:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install thermometers in the following locations:
 1. Inlet and outlet of each boiler.
 2. Inlet and outlet of each hydronic coil in air-handling units.
- B. Provide the following temperature ranges for thermometers:
 1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

- A. Install pressure gages at inlets and outlets of pressure reducing valves.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- E. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 23 05 19

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Support information in this section is for steel pipe only. See spec section
- B. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- C. See Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- D. See Division 23 Section "Mechanical Vibration and Seismic Controls" for vibration isolation devices.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

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

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

- 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. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 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. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.
 - 3. Globe Pipe Hanger Products, Inc.
 - 4. Grinnell Corp.
 - 5. National Pipe Hanger Corporation.
 - 6. PHD Manufacturing, Inc.
 - 7. PHS Industries, Inc.
 - 8. Piping Technology & Products, Inc.
 - 9. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

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

2.4 METAL FRAMING SYSTEMS

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

2.5 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 zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 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 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 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.
- 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. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 6. 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.
 - 7. 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.
 - 8. 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.
- 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.
- 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-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. 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:
 8. Light (MSS Type 31): 750 lb.
 9. Medium (MSS Type 32): 1500 lb.
 10. Heavy (MSS Type 33): 3000 lb.
 11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 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. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. 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.
- 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 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. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. 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.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- L. 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.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Hydronic Piping: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 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.

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.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Elastomeric isolation pads and mounts.
 - 2. Restrained elastomeric isolation mounts.
 - 3. Freestanding and restrained spring isolators.
 - 4. Housed spring mounts.
 - 5. Elastomeric hangers.
 - 6. Spring hangers.
 - 7. Spring hangers with vertical-limit stops.
 - 8. Thrust limits.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Seismic snubbers.
 - 12. Restraining cables.
- B. Definitions:
 - 1. Effective peak velocity related acceleration coefficient.
 - 2. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment, plus connected piping and ductwork.
- B. The following equipment shall be provided with vibration isolators:
 - 1. Air Handlers
 - 2. Exhaust Fans
 - 3. Pumps
- C. Provide minimum static deflection of isolators for equipment as follows:
 - 1. 400 – 600 rpm: 3.5 inch
 - 2. 601 – 800 rpm: 2 inch
 - 3. 801 – 900 rpm: 1 inch
 - 4. 901 – 1500 rpm: 0.5 inch
 - 5. Over 1500 rpm: 0.2 inch

1.3 SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device indicated.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 4. Details for Interlocking Snubbers: Include load deflection curves up to ½-inch (13-mm) deflection in x, y, and z planes.

1.4 SEISMIC RETRAINT REQUIREMENTS

- A. Equipment, piping, ductwork and all system appurtenances (including weight of normal operating contents) shall be adequately restrained to resist seismic forces.
- B. All ductwork and piping shall be provided with seismic restraints in accordance with the IBC, UBC, and applicable State and local codes.

1.5 QUALITY ASSURANCE

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage pre-approval “R” number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a registered professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 deg rees to the weakest mode.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code—Steel.”

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 VIBRATION ISOLATORS

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. B-Line Systems, Inc.
3. California Dynamics Corp.
4. Isolation Technology, Inc.
5. Kinetics Noise Control, Inc.
6. Mason Industries, Inc.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation Co., Inc.
9. Vibration Mountings & Controls/Korfund.

B. Type E-1:

1. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
 - a. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
 - b. Minimum $\frac{3}{4}$ " thick.
 - c. Max Loading 40 PSI.

C. Type E-2:

1. Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
2. Durometer values range from 30 to 70 and are measures of hardness or, indirectly, deflection. Lower durometer values indicate softer material with more deflection.

D. Type E-3:

1. Restrained Elastomeric Mounts: All-directional elastomeric mountings with seismic restraint.
 - a. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
 - b. Neoprene: Shock-absorbing materials compounded according to, the standard for bridge-bearing neoprene as defined by AASHTO.

E. Type E-4:

1. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

F. Type S-1:

1. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 - a. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

- b. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - c. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - d. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - e. Baseplates: Factory drilled for bolting to structure and bonded to ¼-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
 - f. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- G. Type S-2:
- 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - a. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to ¼-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- H. Type S-3:
- 1. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
 - a. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 - b. Base: Factory drilled for bolting to structure.
 - c. Snubbers: Vertically adjustable to allow a maximum of ¼-inch (6-mm) travel before contacting a resilient collar.
- I. Type S-5:
- 1. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

J. Type S-5:

1. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - g. Adjustable Vertical Stop: Steel washer with neoprene washer “up-stop” on lower threaded rod.

K. Type T-1:

1. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
 - a. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - g. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

L. Type IB-1

1. Inertia Base.
2. Concrete filled base sized to support equipment without overhanging structural steel members that form perimeter framing. Cutout in center may be provided with structural member interior section to adjust base weight if necessary. Total mass of base shall not be less than two times the total weight of all equipment mounted on base unless otherwise indicated. Submit calculations for base deflection. Deflection shall be in accordance with 1995 ASHRAE Handbook, Vibration Isolation. Furnish with preset embedded anchor bolts and pipe sleeves for fan and motor slide rail or other equipment attachment. Size base to support suction elbow of end suction pumps and suction and discharge elbow of horizontal split case pumps, unless flexible neoprene elbows are used. Use T-shape where necessary to conserve weight and size.

M. Type SB-1

1. Structural Steel Base.
 2. Structural steel rectangular base with cross members to prevent twisting where longest beam dimension exceeds 6 feet. Use height-saving brackets for side mounting of isolators.
- N. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of ~~½-inch~~ thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of ~~500 psig~~ and for equal resistance in all directions.
- O. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of ~~½-inch~~ thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.3 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers:
1. Amber/Booth Company, Inc.
 2. B-Line Systems, Inc.
 3. California Dynamics Corp.
 4. Kinetics Noise Control, Inc.
 5. Loos & Co., Inc.; Cableware Technology Division.
 6. Mason Industries, Inc.
 7. TOLCO Incorporated.
 8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 9. Vibration Eliminator Co., Inc.
 10. Vibration Isolation Co., Inc.
 11. Vibration Mountings & Controls/Korfund.
- B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.
- C. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.
- D. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

- E. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide in accordance with manufacturers instructions.
- B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.
- C. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- D. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- E. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.
- F. Install resilient bolt isolation washers on equipment anchor bolts.
- G. Connect wiring to isolated equipment with flexible hanging loop.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect isolator seismic-restraint clearance.
 - 2. Test isolator deflection.
 - 3. Inspect minimum snubber clearances.

3.3 ADJUSTING

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of $\frac{1}{4}$ -inch movement during start and stop.
- D. Adjust air spring leveling mechanism.
- E. Adjust active height of spring isolators.

- F. Adjust snubbers according to manufacturer's written recommendations.
- G. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- H. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.4 VIBRATION ISOLATOR AND SEISMIC-RESTRAINT SCHEDULE

- A. Compressors
 - 1. Type S-2 restrained spring
 - 2. Type S-3 seismic spring with snubbers
- B. Internally isolated air handling units and fans
 - 1. Springs provided with air handling units and factory installed inside unit casing.
 - 2. Type neoprene waffle pads between base and floor or housekeeping pad.
- C. Fans and air handling units without internal isolations.
 - 1. Type S-2 restrained spring
 - 2. Type SA-3 seismic spring
 - 3. Type SB-1 structural steel base unless unit includes an integral steel base with isolator mounting locations
- D. Suspended fan coil units and fans.
 - 1. Type S-5 Spring Hanger

END OF SECTION 23 05 48

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.
 - 5. Warning tags.

1.3 ACTION 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. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 - 1. Heating Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

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; 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 subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Heating Water: 1-1/2 inches, round.
 - 2. Valve-Tag Color:
 - a. Heating Water: Natural.
 - 3. Letter Color:
 - a. Heating Water: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

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 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Primary-Secondary hydronic 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 INFORMATIONAL SUBMITTALS

- A. Certified TAB reports.
- B. Sample report forms.
- C. 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.
- B. 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.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Construction Manager.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

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 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:
1. Energy Control, Inc.
 2. Testcomm
 3. Riley Engineering, Inc.
 4. Precision Air and Water Balance.
 5. Air Commander Test & Balance

3.2 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.

- C. 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.
- D. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "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.
- E. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- F. Examine test reports specified in individual system and equipment Sections.
- G. 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.
- H. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- J. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 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.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- 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. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping 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.

3.5 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 Section 233113 "Metal Ducts."

3.6 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. Make adjustment of fan speed higher or lower than indicated speed as required to achieve the scheduled air flows. Comply with requirements in HVAC 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. 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.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Section 232123 "Hydronic Pumps."
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.10 PROCEDURES FOR MOTORS

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

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. 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.
- C. Measure, adjust, and record the following data for each steam coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Airflow.
 - 3. Air pressure drop.

4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.12 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.

3.13 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.

3.14 FINAL REPORT

- A. 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 and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. 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.
 - m. Vortex 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. Refrigerant expansion valve and refrigerant types.

- m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in deg F.
 - o. Inlet steam pressure in psig.

- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btu/h.
 - i. High-fire fuel input in Btu/h.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.

- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.

- g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft..
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. 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.
- J. 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.
- K. 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.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.

- d. Make and size.
- e. Model number and serial number.
- f. Water flow rate in gpm.
- g. Water pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.
- 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- 3. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.15 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:

3. 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.
 4. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
 5. 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.
 6. 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."
 7. 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.
- B. 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.
- C. Prepare test and inspection reports.
- 3.16 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 23 05 93

SECTION 23 07 13 – HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Insulation materials and accessories.
- B. New Work: Completely insulate all new work as specified and scheduled.
- C. Existing Work:
 - 1. Insulate all existing piping and ductwork where existing insulation is damaged, as if it is new piping or ductwork.
- D. Coordination:
 - 1. Coordinate size and location of supports, hangers, and insulation shields specified in other sections.
 - 2. Coordinate clearance requirements with piping installer for piping insulation application, duct installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

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. Submit product information for all insulation, jackets, adhesives, closure devices, strapping, and special covers for fittings, valves and pumps.
- C. Manufacturer's Stamp or Label: Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand and description of material.
- D. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
 8. Detail field application for each equipment type.
- E. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
1. Sample Sizes:
 - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - b. Sheet Form Insulation Materials: 12 inches square.
 - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - d. Sheet Jacket Materials: 12 inches square.
 - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- F. Qualification Data: For qualified Installer.
- G. 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.
- H. Field quality-control reports.
- 1.4 QUALITY ASSURANCE
- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM Standard 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. Insulation shall have a flame spread index of 25 or less and smoke developed rating index of 50 or less.
- B. Insulation materials: Insulation materials must be manufactured at facilities certified and registered with an approved register to conform to ISO 9000 Quality Standard.
- 1.5 COORDINATION
- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23.
- 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 before installation of insulation.

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, or added ureaformaldehyde resins.
- 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.

2.2 PIPE INSULATION

- A. Thermal requirements for all Pipe Insulation: Insulation thickness and/or R-value shall be as required by the local energy code or as indicated, whichever is greater.
- B. Glass Fiber Preformed Pipe Insulation: Glass fiber meeting ASTM C547, rigid molded. "K" value 0.23 at 75°F. Maximum service temperature shall not exceed 850°F. Jacket shall be high density, white Kraft bonded to aluminum foil, for vapor barrier, reinforced with fiberglass yarn, permanently treated, secured with self-sealing longitudinal laps and butt strips or AP jacket with outward clinch expanding staples coated with vapor barrier mastic.
 - 1. Manufactures:
 - a. Johns Manville "Micro-Lok AP-T Plus."
 - b. Knauf Fiber Glass "Pipe Insulation."
 - c. Owens-Corning ASJ/SSLII.
- C. Calcium Silicate Pipe Insulation: Rigid molded pipe insulation, asbestos-free, meeting ASTM C533, color coded throughout, "K" value 0.40 at 300°F, maximum service temperature 1200°F, minimum compressive strength of block form not less than 200 psi with 5% compression at 1-1/2" thickness. Non-combustible test4ed per ASTM E-136. Secured with 16-gauge stainless steel tie wire with twisted ends on maximum 12-inch centers.
 - 1. Basis of Design: Johns Manville "Thermo-12 Gold"
 - 2. Manufacturers:
 - a. Johns Manville "Thermo-12 Gold."

- b. Owens-Corning "Kaylo."
- c. Pabco "Super Cal temp Gold."

2.3 FIELD APPLIED JACKETS

- A. Jacketing of Pipes Exposed to Weather: All piping exposed to weather shall be finished with an aluminum jacket over the insulation. Aluminum jacket material shall be embossed or corrugated sheet, 0.016" nominal thickness, conforming to ASTM B209, temper H-14. Jacketing shall be applied with joints lapped not less than 2", and shall be secured with 3/8" x 0.020" thick aluminum bands located at each circumferential lap and at not more than 9" intervals throughout. Horizontal joints shall lap downward to shed water. Vertical joints shall be sealed with weatherproof silicone sealant.
 - 1. Manufacturers:
 - a. Childers Products, Division of ITW "Metal Jacketing Systems."
 - b. Pabco Metals Corporation. "Surefit."
 - c. RPR Products Inc. "Insula-Mate."
- B. PVC Plastic: One-piece molded type fitting covers and jacketing material, gloss white. Connections, tacks, pressure sensitive color matching vinyl tape. PVC material shall be 25 flame spread and 50 smoke development rated per ASTM E-84.
 - 1. Manufacturers:
 - a. Johns Manville "Zeston 2000 PVC".
 - b. Knauf Fiber Glass "Proto Fitting Cover System".
 - c. Speedline Corporation "Smoke Safe".
- C. Canvas Jacket: UL Listed fabric, 6 oz/sq.yd. plain weave cotton treated with dilute fire retardant lagging adhesive.
 - 1. Manufacturer: Great Lakes Textiles Product Style 1979
- D. Butt Straps: Materials shall be identical in all respects and appearance to the basic jacket material.

2.4 EQUIPMENT AND DUCTWORK INSULATION

- A. Thermal Requirements for all Equipment Insulation: Insulation thickness and/or R-value shall be as required by the local energy code or as indicated, whichever is greater.
- B. Flexible Glass Fiber Blanket: Flexible glass blanket shall conform to ASTM C533. "K" value 0.24 at 75°F. Maximum service temperature, 450°F. Density, 1.5 lb./cu.ft.
 - 1. Vapor Retarder Jacket: Aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft, secured with UL Listed pressure sensitive tape and/or outward clinch expanding staples and vapor barrier mastic as needed.
 - 2. Manufacturers:
 - a. Johns Manville Type 812 "Spin-Glas."
 - b. Knauf Fiber Glass "Insulation Board."
 - c. Owens/Corning Fiberglas Type 703.

- C. Hydrous Calcium Silicate: Rigid molded block conforming to ASTM C533. Asbestos-free color coded throughout material thickness and maintained throughout temperature range. K value, 0.40 at 300°F. Maximum service temperature shall be 1200°F. Compressive strength minimum of 200 psi to produce 5% compression based on 1-1/2" thickness. Non-combustible as determined by test following ASTM E136.
 - 1. Securement: Insulation shall be securely banded in place, tightly butted, joints staggered and secured with 16 gauge stainless steel wire or ½" x 0.015" galvanized steel bands on 12" maximum centers for large areas.
 - 2. Manufacturer:
 - a. Johns Manville "Thermo-12 Gold."
 - b. Owens-Corning "Kaylo."
 - c. Pabco "Super Caltemp."

2.5 DUCTWORK INSULATION

- A. Flexible Fiberglass Blanket: Flexible glass fiber blanket insulation shall meet ASTM C553 and shall be factory-laminated to a reinforced foil/kraft vapor barrier retarder facing, secured with UL Listed pressure sensitive tape and/or outward clinch expanding staples and vapor barrier mastic as needed.
 - 1. Thermal conductivity shall not exceed 0.27 Btu-in. per sq.ft. per °F per hour at a mean temperature of 75°F. Insulation thickness shall be 2.2-inch, 0.75 lb./cu.ft. density, minimum installed thermal resistance shall be R-6.0.
 - 2. Vapor barrier permeance rating shall be not greater than 0.02 perms based on ASTM E96 Procedure A for facing material prior to lamination.
 - 3. Manufacturer:
 - a. Johns Manville "Microlite Type 75."
 - b. Owens/Corning "All-Service Duct Wrap."
 - c. Knauf Fiber Glass "Duct Wrap."
 - d. CertainTeed "Standard Duct Wrap."
- B. Canvas Jacket: UL Listed fabric, 6 oz/sq. yd, plain weave cotton treated with dilute fire retardant lagging adhesive.

2.6 ADHESIVES AND MASTICS

- 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. Obtain insulation and/or jacket manufacturer approval for all adhesives and mastics used. Obtain A/E approval for all locations where mastics will be used.
 - 1. Adhesives shall not be considered an acceptable alternative to specified mechanical fastening methods without prior A/E approval.
 - 2. All adhesives and mastics shall be suitable for the moisture conditions and temperatures that will be encountered.

2.7 SEALANTS

- A. Joint Sealants: Joint Sealants for Cellular-Glass, and Polyisocyanurate Products:
 - 1. Basis of Design: Mon-Eco Industries, Inc. "44-05".

2. Manufacturers:
 - a. Childers Products, Division of ITW; "CP-76".
 - b. Foster Products Corporation
 - c. H.B> Fuller Company; "30-45"
 - d. Mon-Eco Industries, Inc. "44-05"
 - e. Pittsburgh Corning Corporation Pittseal "444".

- B. ASJ Flashing Sealants, and Vinyl, PVDC and PVC Jacket Flashing Sealants. Materials shall be compatible with insulation materials, jackets, and substrates. Fire- and water- resistant, flexible, elastomeric sealant. Minus 40 to plus 250 deg F service temperature range. Color shall be white.

1. Manufacturer: Childers Products, Division of ITW "CP-76".

2.8 TAPES

- A. PVC Tape: White 2-inch wide, vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 1. Basis of Design: Avery Dennison Corporation, Specialty Tapes Division "Fasson 0555".
 2. Manufacturers:
 - 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"
 - d. Venture Tape; "1506 CW NS"

2.9 SECUREMENTS

- A. Bands:
 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M. Type 304; 0.015 inch thick, ½ inch wide with wing or closed seal.
 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; temper H-14, 0.020 inch thick, ½ inch wide with wing or closed seal.
 3. Springs: Twin spring set constructed of stainless steel ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
 4. Manufacturers:
 - a. Childers Products
 - b. PABCO Metals Corporation
 - c. RPR Products, Inc.
- B. Insulation Pins and Hangers:
 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. Manufacturers:
 - a. AGM Industries, Inc. "CWP-1".
 - b. GEMCO "Cupped Head Weld Pin".
 - c. Midwest Fasteners, Inc. "Cupped Head".
 - d. Nelson Stud Welding "CHP".

- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 INSULATION WORK IN GENERAL

- A. General: Except as specified, material shall be installed in accordance with the recommendations of the manufacturer.
 - 1. Do not apply insulation until pipe surfaces to be covered have been leak tested, have had rust and scale removed, and have been cleaned, dried and inspected.
 - 2. Insulation shall be kept dry and clean at all times.
 - 3. Continue insulation vapor barrier through penetrations except where prohibited by code.
 - 4. Continue pipe insulation through gypsum and masonry walls only if fire stopping specified in Division 7 has UL Listed assembly that includes a jacketed insulation. Coordinate with General Contractor.
 - 5. All work shall be performed at ambient and equivalent temperatures as recommended by the manufacturers.
 - 6. Joints shall be staggered on multi-layer insulation.
 - 7. Do not apply insulation until heat tracing specified elsewhere in other sections of this Specification is completed and tested.

3.2 INSULATION INSTALLATION, PIPING

- A. General: Pipe insulation shall be installed in strict conformance to the manufacturer's recommendations. Pipe insulation shall be continuous and installed on all fittings and appurtenances unless specified otherwise. Installation shall be with full-length units of insulation and using a single-cut piece to complete a run. Provide jackets for all pipe insulation.
- B. Insulation Installation on Straight Pipes and Tubes:
 - 1. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 - 3. 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.
- 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. Unions, Flanges, Couplings, Strainers, and Valves
1. Insulate all fittings, flanges, couplings strainers, valves (and similar accessories) associated with an insulated piping system unless indicated otherwise.
 2. Exposed Work: On exposed work, insulate to a diameter equal to insulation of adjacent piping provided a minimum of 1-1/2" of insulation is maintained around fittings, couplings, strainers and valves, otherwise, increase diameter.
 3. Concealed Work: On concealed work, increase insulation diameter to maintain same insulation thickness as on adjacent piping. Use same material as specified for adjacent piping; fitting covers to be as specified hereinafter.
 4. Adjustable and Serviceable Valves and Accessories: Where balancing valves, strainers and similar devices are adjustable or require servicing on less than a five-year cycle, provide removable insulation sections. Where valves with repackable glands and similar devices allow service, but manufacturer does not anticipate service frequency to be less than five years, make reasonable provisions to allow removal and reinstallation of the same materials with minimal effort and potential for damage.
- E. Thermometer and Test Wells: Insulate test thermometer, industrial thermometer, and other test wells over their exterior length. Insulate thermometer wells protruding above finish pipe or equipment insulation. Neatly taper insulation away from top well. Insulation on thermometer wells shall be 1-1/2" minimum thickness.
- F. Insulation Support at Hangers:
1. Provide support shield and 360 degree insert between support shield and piping on piping 1-1/2" diameter and larger. Fabricate hydrous calcium silicate or other heavy density insulating material suitable for the temperature. Shield shall be fabricated of 14 gauge galvanized sheet metal. Insulation shields and inserts shall be not less than the following lengths:

a. 1/2" to 2-1/2"	10"
b. 3" to 6"	12"
c. 8" to 10"	16"
d. 12" and longer	22"
 2. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with lagging adhesive for vapor seal. Where anchors are secured to insulated chilled piping, insulate anchors same as piping for a distance not less than four times insulation thickness to prevent condensation. Vapor seal insulation.
- G. Sleeves and Wall Chases: Insulation on pipes through walls and floors shall be full size and jacketed same as adjacent insulation. Provide a metal jacket over the insulation on pipe passing through sleeves in non-fire rated walls where caulking is required.
1. Where penetrating interior walls, extend the metal jacket 2 inches out on either side of the wall and secure on each end with a band.
 2. Provide adequate support on vertical pipe to prevent slipping.
- H. Allowances for Movement: At Points where pipe will move during expansion and contraction (expansion joints, Z-bends, expansion loops, etc.), clearances between the pipe and encased

insulation shall be sized to permit full pipe movement without cracking or damaging insulation and casing or jacket.

- I. Chilled Water Piping: Insulate all chilled water piping including coil return bends and headers located outside of duct or plenum enclosures.
- J. Insulation at Mechanical Pipe Couplings: PVC insulated fitting covers shall be applied after the insulation is installed. Installation shall comply with the manufacturer's recommended procedures. Connection with the pipe insulation shall be done in a neat, finished appearance, and any required vapor barrier shall be maintained.
- K. Insulation Within Reach of Building Occupants: Where insulation is within reach of building occupants and visitors, insulation surfaces shall be protected by smooth sheet aluminum jacket material, 0.016" nominal thickness, lapped, banded, and installed same as above. The term "within reach" is defined as within ten feet of the floor, except for cases where there is reasonable protection (in the opinion of the A/E) offered by objects located between the insulation and the floor. This does not apply to insulation concealed within wall or ceiling construction and insulation located within equipment rooms that can be locked off from the normal building occupants.
- L. Insulation at Roof Drains and Overflow Drains: Cover body of roof drains with heavy coating of insulation mastic or plastic insulating cement. Finish with canvas or glass cloth covering. Insulate first 10 feet of overflow drain piping.

3.3 PIPING MINIMUM INSULATION SCHEDULE

- A. General: Pipe insulation shall be provided for all piping systems listed below. The operating temperatures listed for the following piping systems shall be the basis upon which the insulation thickness requirements apply.

Heating System Hot Water	200°F
Chilled Water	Below 60°F
Cooling Coil Condensate Drain	Below 60°F
High Pressure Steam	306°F to 450°F
Medium Pressure Steam	251°F to 305°F
Low Pressure Steam	201°F to 250°F
High Pressure Condensate Return and Drip Piping	250°F

- B. Thickness: Thickness of pipe insulation for each application shall be in accordance with the following table:

			Nominal Pipe Size**					
System	Operating	Material	Runouts*	1" &	>1"	>2" to	>4" to	8" &

	Temp. (°F)		Up to 2"	less	to 2"	4"	6"	larger
Heating Water	141-200	Glass Fiber	0.5	1.5	1.5	1.5	1.5	1.5
Heating Water	105-140	Glass Fiber	0.5	1.0	1.0	1.0	1.5	1.5
Chilled Water	40-55	Glass Fiber	0.5	0.5	0.75	1.0	1.0	1.0
*Runouts to individual fan coil, radiation or terminal units not exceeding 12' in length.								
**For piping exposed to ambient air, increase thickness by 0.5",								

3.4 SPECIAL PIPE INSULATION REQUIREMENTS

- A. Vent Piping: Vent Piping from flash tanks, condensate receivers, relief valves, etc., shall be insulated same as condensate return piping whenever such piping is within 7'-0" of any floor or maintenance walkway and in a chase.
- B. Insulated piping and fittings less than 10 feet above finished floor in areas not exposed to public view may be covered with a pre-impregnated canvas jacketing that is wetted and smoothed in place.
- C. Cover plumbing vents within 10 feet of the exterior with 1" nominal thickness, glass fiber insulation.
- D. Cold Piping Insulation: Exposed ends of insulation shall be sealed with vapor retarding mastic installed per the manufacturer's recommendations. Vapor seals at butt joints shall be applied at every fourth pipe section and at each fitting to isolate any water incursion.
- E. Removable Insulation Sections: Installation shall conform to the following:
 1. Fabricate removable insulation sections from sections of pipe insulation or block insulation as follows. Removable flexible blankets will be allowed with prior approval if adequate covering is provided. Vapor barrier must be maintained for cold surfaces.
 2. When covers are made from sectional pipe insulation, extend insulation at least two times the insulation thickness over adjacent pipe insulation on each side of the component. Secure cover in place with stainless-steel hooks and wire.
 3. When covers are made from block insulation, make two halves, each consisting of mitered blocks. Extend insulation at least 2 inches over adjacent pipe insulation on each side of the component. Fill space between the component and pipe insulation with insulating cement.

3.5 INSULATION OF IRREGULAR SHAPE SURFACES

- A. General: Provide reusable insulation pads on the chilled water pump casings, irregular surfaces of chilled water connections to chillers, flanges, flanged chilled water valves, hot water and steam valves. All surfaces shall be covered with bats of glass fiber within silicone-treated glass cloth jackets and with outer vapor barrier finish, made and shaped to fit irregular contour surfaces of the valves. Insulation pads shall be non-oiled, fully enclosed all sides and edges, sewn with glass fiber and stainless steel sewing twine, and with rolled-in blind seams, with bats compressed to 1-1/2" thickness. Attach stainless steel Bergen hooks on 3" centers around all edges of bats, on top surface, laced with stainless steel wire.

3.6 DUCTWORK AND PLENUM INSULATION INSTALLATION

A. General: Insulate the following ducts:

1. Supply air ducts not within conditioned space. R-Value = R-8
2. Return air ducts not within conditioned space. R-Value = R-8
3. Relief air ducts between AHU and exterior space. R-Value = R-8
4. Outside air intakes and ducts within conditioned space. R-Value R-8
5. Supply, return, and outside air ducts in concrete or in ground. R-Value R-6
6. Supply air ducts with supply air temperature $<55^{\circ}\text{F}$ or $>105^{\circ}\text{F}$ within conditioned space. R-Value = R-6
7. Mechanically cooled ducts requiring insulation shall have a vapor retarder jacket.

B. Installation on Concealed Ducts:

1. For all rectangular and all round ducts, insulation shall be attached by applying adhesive around entire perimeter of the duct in 6" wide strips on 12" centers.
2. For rectangular ducts, 24" and larger insulation shall be additionally secured to bottom of ducts by use of mechanical fasteners. Fasteners shall be spaced on 18" centers and not more than 18" from duct corners.
3. Mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18" centers and not more than 18" from duct corners.
4. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to overlap vapor barrier joints 2". The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.
5. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back to the washer.
6. Jacket overlaps shall be secured under the overlap with adhesive and stapled on 4" centers.
7. Staples and seams shall be coated with vapor barrier coating.
8. Breaks in the jacket material shall be covered with patches of the same material as the vapor barrier. The patches shall extend not less than 2" beyond the break or penetration in all directions and shall be secured with adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor barrier coating.
9. At jacket penetrations such as hangers, thermometers and damper operating rods, voids in the insulation shall be filled with vapor barrier coating and the penetration sealed with a brush coat of vapor barrier coating.
10. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.
11. Bands: Bands on 18" centers shall be provided on all insulation on concealed round duct.
12. Flexible Duct Insulation: Flexible ducts have been specified to have factory-applied insulation. This Contractor shall seal all connections with tape.

3.7 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 Fire-rated Floor, Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated floors, walls and partitions if firestop is rated for this approach. Obtain further direction from A/E if firestopping is not rated for insulated penetrations.
1. Comply with requirements in Division 07 Section for firestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.8 FIELD-APPLIED JACKET INSTALLTION

- A. General: Where field-applied jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Install metal jackets 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.

END OF SECTION 23 07 13

SECTION 23 23 00 – REFRIGERATION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410a:
 - 1. Suction Lines for Air-Conditioning Applications: 185 psig.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L drawn-temper tubing.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig .
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 3. Operator: Rising stem and hand wheel.
 - 4. Seat: Nylon.
 - 5. End Connections: Socket, union, or flanged.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze.

2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.

6. Maximum Operating Temperature: 240 deg F.
- G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 deg F .
 6. Superheat: .
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: 450 psig.
- H. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig.
 5. Maximum Operating Temperature: 275 deg F.
- I. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig.
 6. Maximum Operating Temperature: 275 deg F.
- J. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 240 deg F.
- K. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Designed for reverse flow (for heat-pump applications).

4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig .
7. Working Pressure Rating: 500 psig .
8. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Working Pressure Rating: 500 psig .
7. Maximum Operating Temperature: 240 deg F .

M. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

A. Manufacturers:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-410A:

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type L drawn-temper tubing and wrought-copper fittings with brazed joints.

- C. Hot-Gas and Liquid Lines: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install packed-angle valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install packed-angle valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. 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 Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- 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 adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 15 Sections "Controls and Instrumentation, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 8 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.

4. Liquid lines may be installed level.

- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- R. Seal penetrations through fire and smoke barriers according to Division 7 Section "Through-Penetration Firestop Systems."
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- U. Seal pipe penetrations through exterior walls according to Division 7 Section "Joint Sealants" for materials and methods.
- V. Identify refrigerant piping and valves according to Division 15 Section "Mechanical Identification."

3.4 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B 828.
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BA_g, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.

5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 2. NPS 5/8: Maximum span, 60 inches ; minimum rod size, 1/4 inch
 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch
 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch
 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch .
 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch
 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch .
- D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig).
 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rectangular ducts and fittings.
 - 2. Round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 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".

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Factory- and shop-fabricated ducts and fittings.
 - 2. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. Duct sizes shown on drawings are outside nominal dimensions for sheet metal ductwork. Where ductwork is indicated on the drawings to be lined, an allowance for 1" or 2" thick insulation is included and duct sizes do not need to be increased to compensate for the insulation.
- B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Rectangular to round branch duct connections shall use spin-in fittings: Spin-in fittings shall be DuroDyne or Air Control Products equal to Air Control Products Model S-SM-C with damper for unlined ductwork or Air Control Products Model S-DB-C with damper for lined ductwork.
- G. Rectangular to rectangular branch duct connections shall use 45 degree entry. Straight taps are not allowed.
- H. Rectangular Elbows: All 90 degree rectangular elbows shall contain turning vanes. See section 233300 "Air Duct Accessories" for turning vane fabrication requirements.

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 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. McGill AirFlow LLC.
 - b. SEMCO Incorporated.
 - c. Sheet Metal Connectors, Inc.
 - d. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Round ducts and fittings: All round ductwork shall be spiral lock seams with spot welded sealed manufactured fittings, galvanized steel.
- F. Round Elbows: All round elbows shall be pleated or segmented with a centerline radius of 1.5 times the cross section diameter.

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. 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.
- D. 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 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. 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 45 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.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. 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.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- B. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections. Fittings shall be full bodied fittings on all new duct installations. Saddle fittings shall only be allowed on connections to existing duct work.
- C. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- D. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- E. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

- F. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- G. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- H. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 SEAM AND JOINT SEALING

- A. Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches 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.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class 3-Inch wg and higher.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 6. Give seven days' advance notice for testing.

3.6 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel:
- B. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- C. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1500 fpm or lower:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "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) 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

D. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1500 fpm or Lower: Conical tap.
 - b. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Turning vanes.
 - 3. Duct-mounted access doors.
 - 4. Flexible connectors.
 - 5. Flexible ducts.
 - 6. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Manual Volume dampers.
 - 2. Flexible connectors.
 - 3. Flexible ducts.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish.

- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 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. 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. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Vent Products Company, Inc.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 16 gauge minimum thickness.
 - 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, 16 gauge thick.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Galvanized steel.
- B. Jackshaft:
 - 1. Size: 1-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 TURNING VANES

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. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.4 FLEXIBLE DUCTS

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. Thermaflex.
2. Genflex
3. Thermold
4. Wiremold

B. Up to 2" W.G. Pressure Class:

1. Flexible duct shall be a factory assembly consisting of a spring steel helix, inner liner wrapped with 1" thick fiberglass insulation and a vapor barrier outer jacket. Composite assembly, including insulation and a vapor barrier, shall meet U.L. 181 and the Class 1 requirements of NFPA 90-A. Flexible duct shall be Thermaflex G-KKM, Thermold, Genflex or Wiremold.

C. 4" W.G. Pressure Class:

1. Flexible duct shall be a factory assembly consisting of a spring steel helix, inner liner wrapped with 1" thick fiberglass insulation and a vapor barrier outer jacket. Composite assembly, including insulation and a vapor barrier, shall meet U.L. 181 and the Class 1 requirements of NFPA 90-A. Flexible duct shall be equal to Thermaflex M-KC. Duct shall be designed for 4" pressure application.

D. Flexible Duct Clamps: Nylon strap in sizes 3 through 18 inches to suit duct size.

2.1 DUCT-MOUNTED ACCESS DOORS

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. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. 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 and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.2 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 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.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install combination fire/smoke dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Adjacent to and close enough to combination fire/smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 3. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Minimum Sizes:
 - 1. One-Hand or Inspection Access: 8 by 6 inches.

2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body plus Ladder Access: 25 by 17 inches.
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. 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 and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00

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 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Square ceiling diffusers.
 - 2. Adjustable bar grilles.
 - 3. Fixed face grilles.
- B. Related Sections:
 - 1. Division 08 "Operable Wall Louvers" and Section 089119 "Fixed Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 "Air Duct Accessories" for fire and smoke dampers and 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.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

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. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.

4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Square Ceiling Diffusers:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Krueger.
 - b. Nailor Industries Inc.
 - c. Price Industries.
 - d. Titus.
 - e. Tuttle & Bailey.
 2. Devices shall be specifically designed for variable-air-volume flows.
 3. Material: Steel or Aluminum as scheduled.
 4. Finish: Baked enamel, white or as scheduled.
 5. Mounting: As scheduled.
 6. Pattern: Adjustable.
 7. Dampers: As scheduled.

2.2 REGISTERS AND GRILLES

- A. Adjustable Bar Grille:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Krueger.
 - b. Nailor Industries Inc.
 - c. Price Industries.
 - d. Titus.
 - e. Tuttle & Bailey.
 2. Material: Steel or Aluminum as scheduled.
 3. Finish: Baked enamel, white or as scheduled.
 4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
 5. Core Construction: Integral.
 6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
 7. Frame: 1 inch wide.
 8. Mounting: As scheduled.
- B. Fixed Face Grille:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Krueger.
- b. Nailor Industries Inc.
- c. Price Industries.
- d. Titus.
- e. Tuttle & Bailey.
2. Material: Steel or Aluminum as scheduled.
3. Finish: Baked enamel, white or as scheduled.
4. Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Mounting: As scheduled.

2.3 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.

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SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

END OF SECTION 23 37 13

SECTION 23 81 29 – VARIABLE REFRIGERANT FLOW SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. The heat recovery variable refrigerant flow system is a three-pipe system consisting of a single or multiple outdoor units, multiple indoor units of various types and capacities, and multiple flow selector boxes, individual or central indoor unit controls with on/off temperature settings, all connected by fully insulated refrigerant lines utilizing factory-supplied, fully insulated branching kits. Indoor units are connected to condensate piping that shall be terminated to the nearest drain point.
- B. The system shall be fully capable of simultaneous heating and cooling operation as requested by the individual indoor zones that can consist of single or multiple indoor units.
- C. The maximum number of connected indoor units shall not exceed 48.
- D. The total connected indoor unit capacity shall range between 80 and 125% of the outdoor unit capacity.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Units shall be listed by ETL (Engineering Testing Laboratory) and be evaluated in accordance with UL standard 1995, 4th. edition.
- B. Units shall be listed in the AHRI directory.
- C. All units shall meet the Federal minimum efficiency standards and be tested per AHRI 1230 Standard.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be shipped in one piece and shall be stored and handled per unit manufacturer's recommendations.
- B. Units shall be supplied with sufficient packaging and rigging for a base rail that provides openings for moving the unit by fork truck or rigging the unit by crane.

1.5 WARRANTY

- A. The units shall have a manufacturer's warranty for the period of one (1) year from the date of installation. The units shall have limited labor warranty for a period of one (1) year from the date of installation. The compressor shall have a warranty of six (6) years from the date of installation.
- B. The system shall be installed by a factory trained contractor/dealer.

PART 2 - PRODUCTS

2.1 OUTDOOR AND DISTRIBUTION EQUIPMENT

- A. General: Factory-assembled, single-piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the multiple inverter-driven twin rotary compressors.
 - 1. The maximum sound pressure rating for a single module shall not exceed 63.5 dBA sound pressure in cooling and 65.5 dBA in heating. For twinned systems the sound pressure level shall not exceed 66.5 dBA and 68.5 dBA. For 3-module systems the sound pressure level shall not exceed 68.0 dBA and 70.0 dBA. Sound pressure ratings are measured at a distance of 3 ft out and 4 ½ ft up from the side of the outdoor unit.
 - 2. The outdoor unit shall include an oversized accumulator and a liquid tank for proper heating performance while allowing the indoor unit PMV (pulse modulating valve) metering device to shut off completely when a zone is satisfied.
 - 3. The outdoor unit shall be protected by a high-pressure switch, high-pressure sensor, low-pressure sensor, fusible plug, PC board, and an inverter overload protector.
 - 4. The outdoor unit shall be capable of operating in cooling mode down to 14 F dry bulb ambient air temperature and down to -4 F wet bulb ambient air temperature in heating. For simultaneous heating and cooling the unit shall be capable of operating between 14 F and 60 F ambient air temperature.
 - 5. The outdoor unit shall include a total oil management system that balances oil between compressors within a module, replenishes compressor oil to the compressors in a module from the oil separator if required, and allows oil and refrigerant to move between twinned or 3-module units if required, even if one of the units is not running.
- B. Unit Cabinet:
 - 1. Unit cabinet shall be constructed of pre-coated steel, finished on both inside and outside.
 - 2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressors, fan, and control components.
 - 3. Compressors shall be isolated in a compartment and have an acoustic wrap to assure quiet operation.
 - 4. The outdoor unit control panel shall include a sliding window to access adjustable controls and an LED display for setup and diagnostics.
 - 5. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061).

- C. Fans:
 - 1. Outdoor fan shall discharge air vertically and be driven by a DC-inverter variable-speed motor with 64 steps that is capable of running down to 60 rpm.
 - 2. Outdoor fan motor shall be totally-enclosed with permanently-lubricated bearings.
 - 3. Motor shall be protected by internal thermal overload protection.
 - 4. Fan blade shall be non-metallic and shall be statically and dynamically balanced.
 - 5. Outdoor fan shall be protected by a raised non-metallic protective grille.
- D. Compressors:
 - 1. Each outdoor unit module shall be equipped with two or three inverter-driven twin rotary compressors with full-range control to an accuracy of ± 0.1 Hz.
 - 2. Compressor shall be totally enclosed in the machine compartment.
 - 3. Compressors shall be equipped with factory-mounted crankcase heaters.
 - 4. Internal safety logic shall protect the compressor from over-temperature operation.
 - 5. Motor shall be suitable for operation in an R-410A refrigerant atmosphere.
 - 6. Compressor assembly shall be installed on rubber vibration isolators.
 - 7. To maximize compressor reliability, multiple compressors within a module shall be started and operated in variable patterns to ensure equal run time on all compressors.
 - 8. To ensure maximum efficiency throughout the system operation range, no compressor is required to run at maximum speed under any condition.
- E. Outdoor Coil:
 - 1. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
 - 2. The coil configuration shall be 4-sided and fully separated from the machine compartment for more effective heat transfer and sound isolation.
 - 3. The coil fins shall have a factory-applied corrosion resistant blue-fin finish.
- F. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
 - 1. Controls:
 - a. Compressor speed to match the refrigerant flow and capacity with the system requirements.
 - b. Outdoor fan motor speed for higher efficiency and lower sound.
 - c. Oil control for improved system reliability and comfort
 - d. Pulse modulating valve control for precise control of the refrigerant distribution and accurate capacity management to avoid starving any units.
 - e. Control of compressor staging to maximize reliability and minimum run time on all compressors.
 - f. Module control of compressor operation, compressor speed, and outdoor heat exchanger surface to maximize efficiency and sound level and reliability across the entire operating range of the system.
 - g. Control of the outdoor heat exchanger surface (main vs sub heat exchangers) for maximum efficiency and comfort.
 - 2. Safeties: The following safety devices shall be part of the condensing unit:
 - a. High-pressure switch
 - b. Fuses

- c. Crankcase heater
 - d. Fusible plug
 - e. Over current relay for the compressor
 - f. Thermal protectors for compressor and fan motor
 - g. Compressor time delay
 - h. Oil recovery system
 - i. Oil level sensor
 - j. Over-current sensor
 - k. Compressor suction and discharge temperature sensor
 - l. Compressor suction and discharge pressure sensor
- G. Electrical Requirements:
- 1. All sizes shall utilize 208/230-3-60 or 460-3-60 (V-Ph-Hz) field power supply.
 - 2. Modular systems shall have separate field power supply to each module.
 - 3. Two-core, standard, shielded low voltage cable shall be required for communication between outdoor and indoor unit.
 - 4. All power and control wiring must be installed per NEC and all local electrical codes.
- H. Refrigerant Piping and Line Lengths:
- 1. Piping connections shall be from the front or the bottom of the unit.
 - 2. The unit shall be capable of operating with maximum connected refrigerant line lengths of 985 ft (actual).
 - 3. The outdoor unit shall have the ability to operate with a maximum height of 165 ft. between the outdoor and the lowest indoor unit.
 - 4. The maximum distance between the outdoor unit and the furthest fan coil shall not exceed 591 ft actual or 656 ft equivalent. No line size changes, or oil traps shall be required.
 - 5. The system shall be capable of operating when the height difference between the upper and the lower fan coil is 130 ft.
- I. Auxiliary Refrigerant Components:
- 1. All field supplied copper tubing connecting the outdoor unit to the indoor unit shall use factory-supplied branching kits consisting of either Y joints or headers to ensure even refrigerant flow.
 - 2. To ensure piping flexibility the system shall allow having Y joints or headers downstream of another header.
 - 3. For modular systems, in order to maximize efficiency and comfort, a 3/8-in. oil balance line shall be used to allow the flow oil and refrigerant between the modular units even when one of the units is not running.
 - 4. A flow selector box will be required to regulate the flow of high-pressure hot gas or high-pressure liquid to the fan coil requiring heating or cooling.
 - 5. Up to 8 fan coils, all requiring same duty cycle, may be connected to a single flow selector box.
 - 6. A fan coil that runs in cooling only shall not be required to connect to a flow selector box.
 - 7. The flow selector box can be installed up to 49 ft from the indoor unit.

8. The flow selector box shall be wired from the indoor unit using a factory-supplied power and control wire harness.
9. The flow selector box shall not require a drain connection.
10. The flow selector box shall include a galvanized steel enclosure, full interior insulation, and shall be tested prior to shipment.

2.2 INDOOR EQUIPMENT

A. Floor Console Exposed Indoor Unit

1. General: Indoor, direct-expansion, floor console exposed fan coils. Unit shall be complete with a coil, fan driven by AC induction motor, PMV (pulse modulating valve), piping connectors, electrical controls, microprocessor control system, integral temperature sensing, and hanging brackets.
2. Unit Cabinet: Cabinet shall be constructed of zinc-coated steel and configured for bottom return.
3. Fans: The fan shall be of the multi-blade type with performance designed to match the coil performance. The fan shall be statically and dynamically balanced to ensure low noise and vibration.
4. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wettability. A drip pan under the coil shall have a factory-installed drain connection for hose attachment to remove condensate.
5. Motors: Motors shall be totally enclosed, permanently lubricated ball bearing with inherent overload protection.
6. Controls: The system shall be microprocessor controlled to maintain precise room temperature and minimum power consumption. The controls system shall employ a genetic algorithm for temperature control.
 - a. The unit shall have the following functions as a minimum:
 - 1) Selectable automatic restart. After power failure the system will restart at the same operating conditions as before the failure.
 - 2) Temperature-sensing controls shall sense return air temperature at the unit or at the remote control
 - 3) Indoor coil freeze protection in both cooling and heating (reversing valve failure) modes.
 - 4) Dehumidification mode shall provide increased latent removal through total system modulation.
 - 5) Fan-only operation to provide room air circulation when no cooling is required.
 - 6) Fan speed control shall be user set to one of three speeds by using the taps on the motor.
 - 7) Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature in heating.
 - 8) Cold blow prevention in heating.
 - 9) Adjustable compensation for air stratification in heating.
7. Filters: The filters shall be field supplied.
8. Electrical Requirements: Indoor units are 208/230-1-60 (V-Ph-Hz).

2.3 CONTROLS

- A. Central controller shall communicate over two-core shielded wire using existing in-door outdoor communication protocol to communicate. A single central controller shall be capable of controlling all indoor units individually. It shall provide master, weekly, five special day and monthly scheduling feature. In addition, an optional digital I/O interface shall provide alarm, fire and locking signals. It shall provide a web interface for remote monitoring, control, and scheduling.
- B. Management Systems: Manufacturer shall provide standalone system with main controller touch screen located in the as indicated on the drawings. Standalone system shall control all aspects of the variable flow system.
- C. The unit shall have the following functions as a minimum:
 - 1. Selectable automatic restart. After power failure the system will restart at the same operating conditions as before the failure.
 - 2. Temperature-sensing controls shall sense return air temperature at the unit or at the remote control
 - 3. Indoor coil freeze protection in both cooling and heating (reversing valve failure) modes.
 - 4. Automatic air sweep control to provide multiple operating modes of the air sweep louvers.
 - 5. Dehumidification mode shall provide increased latent removal through total system modulation.
 - 6. Fan-only operation to provide room air circulation when no cooling is required.
 - 7. Fan speed control shall be user-selectable: high, medium, low, or microprocessor determined (Auto) based on the differential between the room temperature and the set point during all modes of operations.
 - 8. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature in heating.
 - 9. Cold blow prevention in heating.
 - 10. Adjustable compensation for air stratification in heating.
- D. Overview
 - 1. General:
 - a. The Controls Network shall be capable of supporting remote controllers, centralized controllers, an integrated web-based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.
- E. Electrical Characteristics
 - 1. General:
 - a. The Control Network shall operate at 30VDC. Controller power and communications shall be via a common non-polar communications bus.
 - 2. Wiring:
 - a. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor

unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

3. Wiring type:
 - a. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.
 - b. Network wiring shall be CAT-5 with RJ-45 connection.

F. Input/Output (I/O) Boards

1. Advanced HVAC Controller (AHC)
 - a. The AHC shall be capable of providing programmable binary and analog inputs and outputs to control general equipment in conjunction with indoor unit functions and states. Input and output states and values shall be monitored through the EB-50GU or the Smart ME Remote controller. The Smart ME remote controller shall be able to adjust temperature and humidity set points for equipment controlled by the AHC. In addition to analog and binary inputs the AHC can monitor M-NET equipment states and sensor values. Available inputs include room temperature, room humidity, occupancy, brightness, outdoor temperature, inlet/outlet water temperature (PWFY), on/off state, mode, ventilation on/off, error status. In addition to programmable analog and binary outputs, the AHC can control indoor unit on/off, mode, temperature set point, fan speed, LOSSNAY on/off and LOSSNAY fan speed.

G. Digital Input Digital Output (DIDO) Board

1. The DIDO board shall be capable of providing On/Off control for non-Mitsubishi Electric equipment via the AE-200/AE-50/EB-50GU Centralized Controller's licensed web browser functions, the touch screen of the AE-200, AE-50, and TC-24 Centralized Controller, the interlock function of the AE-200/AE-50/EB-50GU and the TG-2000 software. Each DIDO board shall have two digital inputs and two digital outputs. Each digital output shall be capable of supporting an independent schedule via the AE-200/AE-50/EB-50GU Centralized Controller's web browser functions and the TG-2000 software. Status indication of the On/Off state of the non-Mitsubishi Electric equipment shall be either via the On/Off status of the digital output or by receipt of a digital input to the DIDO board.
2. The DIDO board shall be capable of receiving a digital input for interlock settings with the CITY MULTI indoor units or digital outputs on the DIDO board. Based on the digital input status the DIDO board shall be capable of setting the following parameter on the indoor unit On/Off, Mode, and Set Temperature to predefined settings. The DIDO board shall also be capable of interlocking the On/Off state of a digital output on the DIDO board based on an onboard channel digital input status or a free contact input status from system indoor units.

H. Analog Input (AI) Board

1. The AI board shall be capable of monitoring temperature or humidity via the AE-200/AE-50/EB-50GU Centralized Controller's web browser functions and the TG-2000 software. Each AI board shall have two analog inputs. Each input shall be capable of receiving a 4/20mA, 0/10 VDC, or 1/5 VDC signal for monitoring temperature or humidity. The AI board shall be capable of monitoring the temperature or humidity input and shall be

capable of displaying graphical trending of the temperature or humidity values via the AE-200/AE-50/EB-50GU Centralized Controller's web browser functions and the TG-2000 software. Notification of user adjustable high- and low-level alarms shall be capable of being emailed to distribution list or outputted via a digital output.

2. The AI board shall be capable of setting the following parameters on the indoor unit On/Off, Mode, and Set Temperature to predefined settings based on the input value of the temperature or humidity. The AI board shall also be capable of interlocking the On/Off state of a digital output on the input value of the temperature or humidity.

I. Centralized Controller (Web-enabled)

1. Centralized Controller

- a. The Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple outdoor units with the use of expansion controllers. The Centralized Controller shall be powered with an integrated 100-240 VAC power supply. The Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. The centralized control shall be able to enable or disable operation of local remote controllers. The Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.
- b. All Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three expansion controllers for display of up to two hundred (200) indoor units on the main interface.
- c. The Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.
- d. Standard software functions shall be available so that the building manager can securely log into each via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics.

2. Expansion Controller

- a. Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the Centralized Controller for the purpose of adding up to 50 indoor units to either the main touch screen interface of the. Up to three (3) expansion controllers can be connected to the via a local IP network (and their IP addresses assigned on the Expansion Controller) to the expansion controller to

allow for up to two hundred (200) indoor units to be monitored and controlled from the expansion controller interface.

- b. The expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the expansion controller and configured to display their units on the main controller, the individual indoor units connected to the expansion controller can still be monitored and controlled from the interface of the expansion controller. The last command entered will take precedence, whether at the wall controller, the expansion controller or the expansion Controller.

J. Power Supply

- 1. The power supply shall supply 24VDC for the centralized controller and 30VDC voltage for the central control transmission.

2.4 APPROVED MANUFACTURERS

- A. Daikin
- B. Mitsubishi
- C. Carrier
- D. LG
- E. Or Engineer Approved Substitution

PART 3 - EXECUTION

3.1 HVAC VARIABLE REFRIGERANT FLOW (VRF) SPLIT SYSTEM

- A. Follow all Manufacturer installation instructions. Set outdoor units on rubber vibration isolation waffle pad. Rubber shall support the outdoor units along the full length of two sides as shown in the installation manual. Insure that vibration isolation pad extends beyond the metal equipment feet in all directions by at least ¼".
- B. Measure all line set lengths as they are unspooled. At the start of refrigerant line installation, notify the Owner, Engineer, and Commissioning agent to coordinate a site inspection of the installation process. Refrigerant line lengths must be measured before installation as line sets are unspooled. Adjust line length measurement by the amount trimmed to determine the actual line length to a tolerance of +/- 3". Record the line lengths of each run of refrigerant piping. Contractor shall maintain legible and clear field notes of all line length measurements. Field notes shall be available for inspection on site. When the refrigerant line installation is complete, provide the Owner, Engineer, and Commissioning Agent with a document that identifies all refrigerant line lengths and changes in line elevation. Insure that no line exceeds Manufacturer's length or elevation limits. Include all length and elevation limits on the field

notes and final document. Prior to installation, notify Engineer of any length or elevation distances that are within 10% of a Mitsubishi limit or recommendation. Calculate the refrigerant charge for each system using the measured line lengths. Record the refrigerant charge for each system on the inside of the service panel of the outdoor unit. Record the refrigerant charge on an engraved label permanently attached to the outdoor unit.

- C. Refrigerant line should be installed with sweeping bends. Avoid creating dips that will trap refrigerant oil. No kinking or distortion of the tubing cross section is permitted. Any kinked copper must be replaced.
- D. Follow best practices and all manufacturer recommendations for brazing.
- E. Refrigerant line shall be supported as required by manufacturer and code.
- F. Refrigerant lines, fittings, and valves shall be insulated with $\frac{3}{4}$ " closed cell insulation. No exposed surfaces shall condense. Seal all openings where refrigerant pipes or wires enter the outdoor unit to prevent rain or snow from entering the cabinet.
- G. Ball valves shall be installed at each BC port to allow partial evacuation of the system. Follow best practices and all Manufacturer recommendations for evacuation testing and charging the system with refrigerant. Notify Owner and Engineer in advance of each evacuation and pressure test and provide test results to Owner and Engineer in writing. Pressure tests shall pressurize the entire system with nitrogen to the recommended 600 psi for a minimum for 24 hours without measurable leakage. Allowances must be made for ambient temperature changes. If the ambient temperature at the end of a test is higher than at the beginning of a test, the system pressure must be greater than the starting pressure.
- H. Notify Owner and Engineer of any loss of refrigerant event. Set all indoor units to control to their wall mounted space temperature sensor.
- I. Review all required DIP switch settings with Engineer and Commissioning Agent. DIP switches and startup shall be set to provide the follow:
 - 1. Control to space temperature sensor located in wall mounted thermostat
 - 2. Automatic restart after loss of power
 - 3. Do not display filter warnings
- J. Use of VRF system prior to final building cleaning must be approved by the Engineer and Owner. Ducting and Fan coils must be protected from construction dust.

3.2 REFRIGERANT LINES

- A. Install refrigeration specialties in accordance with manufacturer's instructions. Properly insulate and support piping. Refrigerant lines must be individually clamped for support. Straps supporting one or more refrigerant lines are not acceptable.
- B. Insulation of refrigerant lines must be continuous. Do not break insulation at pipe clamps and supports.

- C. Protect external refrigerant lines from UV and weather. Clad all exposed refrigerant line with aluminum.
- D. Add guards where necessary to protect refrigerant line from damage due to maintenance personnel or equipment.

3.3 VIBRATION ISOLATION

- A. Suspended or support equipment with rotating parts shall use spring hangers or spring supports properly sized and adjusted to provide a minimum 1" static deflection unless manufacturer requires other deflection or isolator type. Spring hangers shall meet all seismic code requirements as installed.
- B. VRF outdoor units shall be set on rubber waffle pad as recommended by the manufacturer's installation instructions.

3.4 CONDENSATE LINES

- A. Pipe material: Copper Type L or PVC
- B. Joint Type: Solder 95/5 and solvent
- C. Fitting material: Wrought copper or PVC
- D. Pressure rating (PSI): 125

END OF SECTION 23 81 27

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This section is a Division 26 Electrical Demolition section and is part of each Division 26 section.
- B. Drawings and General Provisions of contract, including General and Supplementary Conditions and Division 01 Specification sections apply to work of this section including disposal requirements for hazardous material such as asbestos and PCB's.

1.2 SCOPE OF WORK

- A. The work under this section shall include providing all labor, equipment and materials of every kind necessary to complete the demolition of existing electrical systems as shown on the drawings and described herein.
- B. Demolition is to coincide with the phased construction described in the Division 01 documents. Portions of the facility are to be occupied and operational through portions of the renovation.
- C. Temporary wiring shall be provided as necessary for any occupied portion of the facility to remain in operation. See Division 01 specifications for additional information regarding demolition/construction scheduling requirements.
- D. The demolition drawings are intended to provide a representation of the magnitude and type of demolition required. Other hidden or un-shown demolition or temporary provisions may be required to accomplish the renovation process.
- E. Downtime shall be held to a minimum; outages shall be scheduled at a time acceptable to and approved by the Owner. This may require work involving power outages to be done at night, early morning or other non-standard hours.

1.3 DESCRIPTION OF WORK

- A. General Description Unless Otherwise Noted:
 - 1. Remove and dispose of all existing line voltage and limited energy electrical systems, fixtures and devices indicated for removal.
 - 2. Remove all wiring back to the panel source for existing circuits which are not to be removed or modified.
 - 3. Remove all exposed conduit, support brackets, hangers, etc. for circuits or feeders which are not to be reused or modified.
 - 4. Existing concealed conduits below grade or within unopened walls to remain: Remove boxes, wiring and abandon conduit.
 - 5. Electrical materials removed for re-installation or relocation shall be safely stored. This material is the contractor's responsibility to protect.
 - 6. Prior to demolition the Electrical sub-contractor shall tour the facility with the Demolition and General Contractors to identify and mark all materials that are intended for relocation. Prior to structural demolition, the Electrical Contractor shall remove all materials indicated for relocation at the appropriate time during demolition to ensure

that it is not damaged. Material destroyed by demolition shall be replaced at no additional charge to the owner.

7. The Electrical Contractor shall ensure that power has been turned off to all material being demolished with structure or ceiling prior to demolition work.

B. Demolition Work:

1. Demolition of electrical work shall be performed by the electrical contractor.
2. On existing walls or ceilings to remain, remove the existing light fixtures, receptacles, switches, disconnects, systems devices, surface conduit, surface raceway, wiring, boxes, LV devices, supports, brackets, hangers, etc. as indicated on the electrical demolition plan.
3. The electrical demolition plans show all existing electrical material to be removed but may not indicate associated boxes, raceway or other hardware. With the exception of 4" or smaller flush boxes serving devices or fixtures to be removed, all associated material shall be removed. Larger flush boxes or cabinets shall be cut out and the wall patched back to new "like kind" finish.
4. On walls, floors or ceilings which are to be removed, verify that all power is disconnected prior to demolition. Electrical on and within those structures may be removed for salvage or demolished with the wall structure.
5. Remove all existing low voltage cable installed in conduit and run open.
6. Electrical Panels and Services Equipment: All existing service and branch panels are to remain.
7. The Contractor shall disconnect power and remove all exposed conduit, disconnect switches, starters, etc., associated with mechanical equipment to be removed. Coordinate the extent of this work with Division 23 documents.
8. Contractor shall transport and legally dispose of off-site, all materials resulting from demolition not being salvaged. Refer to Division-01 specifications for disposal procedures involving hazardous materials.
9. Existing concealed conduit and wiring that serves equipment or devices to be removed may be re-used by the contractor provided it meets code and specification requirements and will not interfere whatsoever with the renovation work.

PART 2 - SALVAGE

2.1 SALVAGE

- A. Certain salvageable items will be removed by the Owner prior to awarding the contract, including some existing IT material and video surveillance cameras.
- B. The Owner shall have first salvage rights.
- C. Contractor Salvage: Items of salvageable value to Contractor which are not claimed by the Owner may be removed from the structure as work progresses. Contractor salvaged items must be transported from site as they are removed. Storage or sale of removed items on site will not be permitted.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Condition and Premises: The Owner assumes no responsibility for the actual condition of premises to be demolished. Owner will maintain general conditions existing at time of inspection for bidding purposes.
- B. Protection: Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons.
- C. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to the Owner.
- D. Patch and Repair: Openings left by the removal of electrical equipment or conduit shall be infilled, patched and repaired to meet Division 01 requirements.
- E. Coordinate all demolition work and scheduling with the General Contractor and school district's construction manager.
- F. Equipment demolition shall include removal of all exposed connecting conduit, surface raceways, outlet boxes, etc., either to a point below floor, behind wall surface, etc.
- G. The cost of patching and repairing all walls, ceilings and floors, which are to remain and are damaged, cut, drilled or altered for the installation or removal of electrical work, is the responsibility of Division 26. Repair work is to be performed by and paid for under Division 26. All work to meet Division 01 requirements.
- H. Abandoned Conduit: Cut and remove raceway and wiring to a minimum depth of 2 inches (50 mm) below the surface of adjacent construction. Cap and patch surface to match existing finish. All abandoned circuits that are not concealed are to be removed.
- I. Remove all existing surface conduits, raceways and equipment serving equipment which is not to remain, within demolition areas. Not all existing surface raceways are indicated on the drawings. The Contractor shall tour site and determine the cost for removal of existing surface items and include that cost as part of the bid.
- J. Where existing flush boxes remain on walls which are not to be removed, furred out or covered, provide blank plates as follows:
 - 1. Standard device gang (1, 2, 3 etc.) boxes: Provide nylon ivory blank cover plates. Utilize jumbo plates where necessary to cover masonry rough openings.
 - 2. Non-standard boxes (clock, timers, relays, etc.): Provide custom made solid 14 gauge steel covers. Installed prior to room finish painting

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Common electrical installation requirements.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.

1.2 COMMON ELECTRICAL INSTALLATION REQUIREMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this Section. Applicable Drawings and Technical Specifications herein shall be taken together as one and shall apply and be used in conjunction with Work under this Division 26- "Electrical Specification" and other published Divisions. Comply with these and other Divisions which affect electrical work for requirements of insurance, as-built drawings, shop drawings, permits, guarantee, maintenance manuals, substitutions, etc.
- B. This section specifies the general requirements for Electrical work. Detailed requirements for specific electrical items are specified in other sections and are subject to the general requirements in this section. Provide all electrical labor and materials required for installation as indicated in the drawings and the specifications. All incidental & other materials and labor not specifically called out but that are required to provide a complete and operable electrical installation in accordance with the contract shall be provided. Provide same brand, device, model, or manufacturer for all similar devices or equipment where multiples occur.
- C. Coordinate work under this division with all other work under Contract, including work provided by the Owner's forces. Work also includes conduit/raceway, wiring, and terminations, performed to Division-26 standards, required for electrical equipment furnished under other Division Sections. Contractor is responsible for determining scope of electrical work requirements within other published Division Sections, whether such work is coordinated or indicated on Division-26 documents. Coordinate location of equipment and devices to avoid conflicts with other work. Plan the work ahead of schedule and verify electrical requirements, connections and interface with other trades. Coordinate the installation work to eliminate or minimize cutting and patching. Carefully examine the full set of Contract documents for electrical work and requirements. Extra cost will not be allowed if electrical work is required to be moved due to interference with other work. Extra cost will not be allowed for electrical work indicated in the Contract documents. If other Trades relieve the electrical contractor of any portion of this work, copies of the Release containing a complete and accurate description of the cables and conduits retained by the other Vendor or Trade shall be forwarded to the ARCHITECT/ENGINEER by Transmittal Letter.
- D. All bids, take-offs, or quotes, including those by "Subs", shall be based upon & performed upon entire set of Contract Documents (CD) and physical site walk-through visit, if required. Do not perform bids, take-offs, or quotes with incomplete or partial sets of CD's. Contractor is responsible for determining any Subcontractor scope and contractual requirements, Work, and supervision for Subcontractors, if any. Electrical Contractor who performs this Division's work shall be responsible to the General Contractor; the General Contractor has final

responsibility for this work under this Division. Contractors bidding project for work under this Section must comply with Divisions 0 & 1 bidding stipulations and arrive at all bid amounts confidentially & independently in a competitive manor. Do not unlawfully disclose bids prior to bid opening. Do not improperly influence any party in restricting competitive bids.

- E. By submission of its bid, this Contractor acknowledges that Contractor has examined the plans, specifications, and site to satisfaction for Work under this Division, and this Contractor acknowledges that it has prepared its bid based on full and adequate knowledge of all contract agreements & terms, including price, payment provisions, delivery terms, quantity, quality, and schedule of work required for receipt, storage and protection, installation, and checkout and start-up of affected apparatus items.
- F. Bring questionable, obscure items, apparent conflicts between contract drawings, specifications, governing codes, or utilities regulations, to the attention of the Architect during bidding period. After contract award, notify the ARCHITECT/ENGINEER in accordance with General Provisions.
- G. All proposed substitutions from those shown or specified shall be received by the Engineer at least 10 days prior to Bid. Priors received after 3 p.m. of the 10th prior day will be rejected. Contractor shall supply specific burden-of-proof of equal performance & appearance with documentation such as technical data, calculations, performance, photometric and dimensional “to-scale” cut-sheets or drawings demonstrating or showing that the proposed substitutes are equal to product specified and specifically highlighting any difference. Faxed prior approvals will not be accepted. Subsequent performance, appearance or fit issues of substituted item, even if approved, apart from or different than originally specified item, not brought to the direct attention of the Engineer-of-Record prior to bid, which require additional engineering design work, those additional costs (at prevailing rates) shall be bore solely by the awarded Contractor submitting substitution.
- H. Contractor shall submit, in writing, an RFI, for any apparent or perceived discrepancy, omission, question, conflict or misunderstanding between Contract, Drawings, Codes, Plans, and/or Specifications, prior to submitting bid. Note: The more stringent interpretation may apply; therefore the Contractor shall bid the more stringent provisions or requirements, unless the discrepancy is properly addressed prior to bid. Absence of such written RFI prior to bid shall indicate Contractor has included all provisions in its proposal and/or bid.
- I. All electrical associated and/or related Work described herein is deemed technical in nature and contractor shall make allowances thereof and shall be performed by certified and qualified electricians, and their direct reports, while employed and under direct supervision of and by State Licensed “Unlimited” Electrical Contractor, in State which Project is located, which requires a Master Electrician of Record, & Bonded per Division 0-“Contract” specifications, and be familiar & experienced with such Work indicated herein, & qualified by most recent OSHA certification to work on energized equipment. Refer to & comply with OSHA 29CFR.1910 & 1926 electrical safety portions. Contractor and direct reports shall have obtained/be current and be deemed “qualified person” per 29 CFR 1910.332(b)(3). Contractor is responsible for determining safety requirements. All electrical related work shall be performed during proven de-energized conditions including lock-out/tag-out methods whenever possible. Assumed condition is “Energized” until proven otherwise. Contractor is responsible for determining construction method and means (M/M) and M/M requirements. Contractor shall provide Work within standard of care for profession. Contractor is responsible for field-determinations pertaining to continued use or suitability of equipment for a specific or intended purpose, environment, or application.

- J. TECHNICAL DEFINITIONS or TERMS – Shall be applied, interpreted, understood, and as defined by NEC Article 100, most recent applicable edition.
- K. Engineer has no responsibility or professional liability and does not represent safeguards or code compliance and does make any express warranty pertaining to or on any plan or portion thereof which was prepared or designed by third parties or others which relates to the electrical plans set of construction documents. Where AHJ in the exercise of official duties presents subsequent approvals, or which approvals are subject to, which contain or make changes to otherwise, in the judgment or opinion of the engineer, code-conforming conditions, directions, or recommendations per plans with which the Contractor complies, AHJ accepts and becomes fully responsible for impacts due to those changes.

1.3 CODES, STANDARDS, MATERIALS, AND FEES

- A. All labor, work and materials provided shall comply with latest (most recently approved) rules and regulations, as modified by WAC-296-46B, of the following standards and codes:
 - 1. National Electrical Code (NFPA 70)
 - 2. Applicable NFPA Publications
 - 3. Applicable IFC Publications
 - 4. Applicable IBC Publications
 - 5. Applicable OSHA Publications
 - 6. Applicable ANSI, ASHRE, UL, NECA and NEMA Standards
 - 7. Requirements of Local Utility
 - 8. Additional Codes and Standards stated in Subsequent Specification sections.
- B. If any conflict occurs between these rules and the drawings and specifications, the rules are to govern. This does not relieve the contractor of complying with any additional requirements as defined by the engineer concerning the plans and specifications which are by design above or in excess of the codes and regulations. If any conflict occurs between General Specification or General Note and a subsequent Specific Specification or Specific Note; the Specific shall prevail, providing code minimums are complied with.
- C. All equipment and materials supplied for this job are to be new & NRTL listed or equivalent with material displaying the appropriate NRTL label. If NRTL labeling is not available for the type of product it shall be specifically noted within the submittals or identified in writing to the Engineer. All equipment and materials shall be installed in strict accordance with Manufacturer's instructions. The voltage rating of electrical equipment shall not be less than the nominal voltage of a circuit to which it is intended.
- D. Contractor shall obtain and pay for all permits and fees required by any government agency having jurisdiction over the work and shall arrange all inspections required by these agencies. Contractor shall notify Owner via General Contractor in writing, within 3 days of inspection, the results of all inspections; including rough in and final. Where Contractor and AHJ make special limited arrangements by permission to document by photograph certain areas intending to be covered-up without inspection; these photographs shall become part of and included within the project "as-built" records and shall include date and brief description.

- E. The contractor shall include in their bid all utility company fees for temporary service work related to the project in their bid. Utility company fees for permanent power and communications shall be paid for by the owner.

1.4 ELECTRICAL DRAWINGS

- A. Electrical Drawings are diagrammatic and are not intended to show all features of work. Contractor shall provide all peripherals and make minor adjustments in order to achieve a complete, working system at no additional cost to Owner.
- B. Install electrical items in a manner to provide symmetrical appearance where not dimensioned on Drawings. Do not scale Drawings for equipment location. Review drawings prepared by other disciplines and adjust work to conform to conditions shown. Data presented on Drawings are as accurate as planning can determine. Dimensional accuracy is not guaranteed and field verification of dimensions, locations, and levels to suit field conditions is required.

1.5 SHOP DRAWINGS AND SUBMITTALS

- A. Submittal documents shall be submitted by the contractor in electronic PDF format, with each specific section submitted as an individual PDF document and named to identify section and content (i.e. 262416 Panelboards); physical copies are not acceptable. The engineer's review of submittals does not relieve the contractor of responsibility to comply with the contract documents and/or governing codes and standards and shall not be construed as authorizing any deviations from the specifications or drawings unless contractor attaches a letter clearly listing the deviation. The burden of proof of equality (see plans or specification section showing "or equal", or "as approved", or "approved equal"), for permitted substitute equipment or materials complying with the specification, is the responsibility of the contractor. Deviations or substitutions from specified requirements not specifically noted in the shop drawings submittals do not constitute an acknowledgment or authorization for such substitution or occurrence unless the said deviation is specifically separately approved (or has prior written approval) in writing and is specifically noted in the submittal.
- B. Shop drawings, catalog sheets, specification sheets and descriptive material shall be submitted in electronic PDF format and be organized and referenced to the applicable specification section. These submittals shall be reviewed by the contractor and stamped approved prior to forwarding for review by the Engineer. Submittals received without contractor's signed note of approval will be subject to return without review. Submittals of individual or piecemeal items will not be accepted unless specifically arranged beforehand with the Engineer.
- C. Engineering shop drawing and/or submittal review, subsequent to General Contractor's approval, is not conducted for the purpose of determining the accuracy and/or completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems. Engineer's review only determines whether the shop drawing and/or submittal generally comply with the information or requirements stated in the contract documents. Shop drawing and/or submittal review by the engineer does not guarantee that the Contractor would perform in accordance with the contract requirements. Shop drawing and/or submittal review by the engineer does not relieve the Contractor of any contract document requirements. Do not submit to Engineer, methods or means of construction or safety related items.

- D. The Architect and Engineer's review of the submittals and shop drawings is intended as a check for general conformance with the contract documents only. Failure by the Architect or Engineer to identify an error in the submittal package does not relieve the contractor of the responsibility for compliance with requirements of the drawings, specifications, and applicable codes.
- E. Submittals on equipment and material shall include: catalog sheets, listing agency ratings, specification sheets, wiring and connection diagrams, layout and dimensions, descriptive material, performance data, operation description and any other data required to show compliance with contract documents. Where manufacturer's catalog cut-sheets show more than one model, configuration or part number; the submittal shall indicate which specific configuration is being submitted including finishes, relay-control options and the like and such submittal shall directly relate to plans identifier (i.e. Light fixture type "R60" or Panel "LDP").
- F. Contractor shall supply submittals (see respective specification sections for additional requirements) on the following items:
 - 1. Panelboards & Overcurrent Devices
 - 2. Receptacles and Switches
 - 3. Disconnect Switches
 - 4. Light Fixtures & Drivers/Emergency Drivers
 - 5. Lighting Control System and Devices
 - 6. Communication cables, racks, patch panels & device plates
 - 7. Intercom and Clock System
 - 8. Fire Alarm System
 - 9. Security System
 - 10. Product Data: For sleeve seals.

1.6 MATERIALS

- A. All materials supplied for this job are to be new & NRTL listed or equivalent with material displaying the appropriate NRTL label. If NRTL labeling is not available for the type of product it shall be specifically noted within the submittals or identified in writing to the Engineer. All equipment and materials shall be installed in strict accordance with Manufacturer's instructions. The voltage rating of electrical equipment shall not be less than the nominal voltage of a circuit to which it is intended.
- B. Provide all electrical labor and materials required for installation as indicated in the drawings and the specifications. All incidental & other materials and labor not specifically called out but that are required to provide a complete and operable electrical installation in accordance with the contract shall be provided. Provide same brand, device, model, or manufacturer for all similar devices or equipment where multiples occur.

1.7 MANUFACTURER'S WARRANTIES

- A. In the event of equipment or component failure during the warranty period, it is the Contractor's responsibility to repair or replace such defective equipment or components and bear all associated costs. The Contractor shall pursue manufacturer's warranties to the extent necessary to obtain replacement equipment and provide proof of action taken upon

request. Assist Owner as directed in determining cause of failure. Each piece of equipment shall meet performance specifications for at least one (1) year of actual operation subsequent to substantial completion.

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.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to or more than 50 inches and 1 or more sides equal to or more than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 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-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 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 penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 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.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260553 "Identification for Electrical Systems"
2. Section 271000 "Structured Cabling Cat-6" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

A. Submit data under provisions for Division 01.

B. Product Data: For each type of product. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authority having jurisdiction and marked for intended use.

B. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5m) when tested in accordance with NFPA 262.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide".
- C. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.
- D. Conductor Insulation:
 1. Type XHHW-2: Comply with UL 44

2.3 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Comply with UL 1569.
 3. RoHS compliant.
 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
 1. Single circuit.
 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation:
 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 2. Type XHHW-2: Comply with UL 44.
- G. Armor: Galvanized steel or aluminum, interlocked.
- H. Jacket: PVC applied over armor.

2.4 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section. Thomas Betts or approved equal.
 - 1. Material: Copper.
 - 2. Type: Two hole with long barrels.
 - 3. Termination: Compression or Mechanical.
- D. Motor connections: Spring wire connectors, pre-insulated "twist-on" rated 105 degrees C per UL 468C. Provide a minimum of 8 wraps of Scotch 33+ electrical tape around conductors and connector to eliminate connector back off.
- E. Wet or exterior: Spring wire connectors, pre-insulated "twist-on", resin filled, rated for direct burial per UL 486D.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Branch Circuit and Feeder color code:
 - 1. Color code conductors by line or phase as follows:
 - a. Black, red, blue and white for 120/208V systems.
 - b. Brown, orange, yellow and gray for 277/480V systems.
 - 2. Conductors 6 AWG and smaller shall have colored insulation.
- B. Feeders: Copper for feeders smaller than 1/0 AWG; copper for feeders 1/0 AWG and larger.
- C. Branch Circuits: Copper, solid for No. 10 AWG and smaller, stranded for No. 8 AWG and larger. Aluminum conductors not approved for use in branch circuit wiring.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2 or XHHW-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2 or XHHW-2, single conductors in raceway.
- D. Feeders Underground: Type XHHW-2, single conductors in raceway.

- E. Feeders in Cable Tray: Power conductors not approved for use in cable tray on this project.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2 or XHHW-2, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC, except home runs which shall be Type THHN/THWN-2 or XHHW-2, single conductors in raceway.
- H. Branch Circuits Underground: Type XHHW-2, single conductors in raceway.

3.3 GENERAL WIRING METHODS

- A. Minimum No. 12 AWG conductors for power and lighting circuits.
- B. Minimum No. 18 AWG conductors for control wiring.
- C. Use No. 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
- D. Make conductor lengths for parallel circuits equal.
- E. Do not share neutral conductors. Provide a dedicated neutral conductor for each branch circuit that requires a neutral.
- F. Place an equal number of conductors for each phase of a circuit in same raceway or cable.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Pull all conductors into a raceway at the same time. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Do not exceed manufacturer's recommended pull tensions.
- D. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely damage conductors has been completed.
- E. 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.
- F. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- H. Neatly train and lace wiring inside boxes, equipment and panelboards.
- I. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems." Do not support cables from ceiling suspension system.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Splice only in accessible junction or outlet boxes.
- C. Stranded wire shall not be wrapped around screw terminals.
- D. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- E. Splices, taps and terminations shall be made to carry the full ampacity of the conductors without perceptible temperature rise.
- F. Control system wiring in conjunction with mechanical, electrical or miscellaneous equipment to be identified in accordance with wiring diagrams furnished with equipment.
- G. Code sound and signal system wiring and any special equipment in accordance with manufacture's diagrams or recommendations.
- H. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.6 IDENTIFICATION

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

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

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

3.9 FIELD QUALITY CONTROL

- A. Conductors shall be carefully inspected for insulation defects and protected from damage as they are installed in the raceway. Where the insulation is defective or damaged, the cable section shall be repaired or replaced at the discretion of the Owner and at no additional cost to the Owner.
- B. Torque conductor connections and terminations to manufacturer's recommended values.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and testing agency's field supervisor.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1. Test Reports:

- a. The results of a 3-point fall of potential ground resistance test, performed on the installed grounding system shall be submitted.
- b. Each test report shall include
 - 1) Date of test, soil moisture content and soil temperature.
 - 2) Test operator.
 - 3) Instrument or other test equipment used.
 - 4) Electrode designation or location matching that shown on shop drawings.
 - 5) Ground impedance in ohms.
 - 6) Assumptions made, if required.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

- A. Grounding Conductors: Copper conductor bare or green insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

- B. Bonding Conductors: Solid bare copper wire for sizes 8 AWG and smaller diameter. Stranded bare copper wire for sizes 6 AWG and larger diameter. Conductors may be insulated if provided with green insulation.
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions. Welding procedure shall include the proper mold and powder charge.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- K. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- M. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel 3/4 inch diameter by 10 foot length.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- B. 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 Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Distribution Transformer: Install grounding electrode(s) at the transformer location. The electrode shall be connected to the equipment grounding conductor on the secondary side of the transformer and the frame.

3.4 EQUIPMENT GROUNDING

- A. Install a separate, insulated equipment-grounding conductor in all feeder and branch circuits. The use of conduit (raceway) systems as an equipment ground path is not allowed. Terminate each end on a grounding lug, bus, or bushing. Multiple conductors on a single lug is not permitted. Each grounding conductor shall terminate on its own terminal lug.

3.5 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 12 inches below finished 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.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each above ground portion of gas piping system downstream from equipment shutoff valve.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify ARCHITECT/ENGINEER promptly and include recommendations to reduce ground resistance.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

1.3 INFORMATIONAL SUBMITTALS

- #### A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- #### B. Coordinate size, shape and location of concrete pads with Division 03.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.
 - c. ERICO International Corporation.
 - d. Substitutions: per Division 01.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel
4. Channel Width: Selected for applicable load criteria

5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

2.3 CONCRETE HOUSEKEEPING PADS

- A. Concrete shall meet the requirements of Division 03, 'Cast-in-Place Concrete'.
- B. Concrete housekeeping pads; 4-inch minimum nominal thickness.

2.4 CONCRETE BASES

- A. Concrete pole bases may be pre-cast or field constructed in accordance with the drawing details.

- B. 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.
- C. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement required are specified in Division 03 Section "Cast-in-Place Concrete".

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
 - 3. NECA 105.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.
 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. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, conduit or ceiling suspension system.
- F. Provide one seismic support wire for all fixtures weighing less than 10lbs, two minimum dedicated seismic support wires for each ceiling-mounted light fixture weighing less than 50lbs. Attach support wirings to building structure independent from ceiling system and on opposing corners of the light fixture to not allow fixtures to drop more than 6 inches upon ceiling failure. Provide four supports for fixtures > 50lbs.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, inner duct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rigid Metal Conduit (RMC, GRC): Comply with ANSI C80.1 and UL 6.
3. Intermediate Metal Conduit (IMC): Comply with ANSI C80.6 and UL 1242.
4. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch, minimum.
5. Electrical Metallic Tubing (EMT): Comply with ANSI C80.3 and UL 797.
6. Flexible Metal Conduit (FMC): Comply with UL 1; galvanized or zinc-coated flexible steel, full or reduced wall thickness.
7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for EMT:
 - a. Material: Steel malleable iron.
 - b. Type: Setscrew or compression.
4. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
5. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 1. Rigid Nonmetallic Conduit (RNC): Schedule 40 PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated. Provide PVC-coated rigid steel factory elbows for bends in all plastic conduit runs, regardless of length.
 2. LFNC: Comply with UL 1660.
- B. Nonmetallic Fittings:
 1. Fittings, General: Listed and labeled for type of conduit, location, and use.
 2. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 3. Fittings for LFNC: Comply with UL 514B.
 4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. B-line, an Eaton business.
 2. Hoffman; a brand of Pentair Equipment Protection.
 3. Square D.
 4. Substitutions under provisions of Division 01.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Cover: Screw cover.
- E. Finish: Rust inhibiting primer coat with gray enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy iron or copper-free cast aluminum Type FD, with gasketed cover.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized cast iron or copper-free aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4-inches square by 2-1/8 inches deep
- I. Gangable boxes are prohibited.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Oldcastle Precast, Inc.
 - b. Quazite: Hubbell Power Systems, Inc.
 - c. Substitutions under provisions of Division 01.
 - 2. Standard: Comply with SCTE 77.

3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "LIGHTING".

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed Conduit: RMC or IMC.
 2. Concealed Conduit, Aboveground: RMC or IMC.
 3. Underground Conduit: RMC or RNC.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
 1. Exposed, Not Subject to Physical Damage: IMC, RMC or EMT.
 2. Exposed and Subject to Physical Damage: RMC or IMC. Raceway locations include but are not limited to the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 3. Concealed in Ceilings and Interior Walls and Partitions: IMC, RMC or EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. Damp or Wet Locations: RMC or IMC.
 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X stainless steel in kitchens and damp and NEMA 250, Type 4X in damp or wet locations.
- C. Minimum Raceway Size:
 1. Below Grade: 1-inch minimum, unless otherwise noted.
 2. Above Grade: 1/2-inch minimum.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing

conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew or compression, steel or malleable iron fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Provide raceways concealed in construction unless specifically noted otherwise, or where installed at surface cabinets, motors and equipment connections and in Mechanical, Electrical, and Telecom equipment rooms. Do not route conduits on roofs, outside of exterior walls or along the surface of interior finished walls unless specifically noted on the plans.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 degrees F

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any mobile walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and hot-water pipes. Install horizontal raceway runs above water piping.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- I. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of 1-inch of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from ENT to GRC or IMC before rising above floor.
- L. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- P. 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. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- R. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Conduit extending from interior to exterior of building.
 4. Conduit extending into pressurized duct and equipment.
 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 6. Where otherwise required by NFPA 70.
- S. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 degrees F and that has straight-run length that exceeds 25 feet.
 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
 3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage and wet locations.
- U. Provide electrical boxes as shown on Drawings and as required for splices, taps, wire pulling, equipment connections, and code compliance. All electrical box locations shown on Drawings are approximate unless dimensioned.
- V. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Where installation is inaccessible, install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaires. Coordinate locations and sizes of required access doors with Division 08.
- W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- X. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Align wall-mounted outlet boxes for switches, thermostats and similar devices.
- EE. Adjust box location up to 6 feet prior to rough-in to accommodate intended purpose.

- FF. Orient boxes to accommodate wiring devices as specified in Section 262726.
- GG. Unless otherwise noted, locate outlet boxes for light switches and lighting control stations within 6 inches of the door jamb on the latch side of the door.
- HH. Provide knockout closures for unused openings.
- II. Do not install flush-mounted boxes back-to-back in walls. Install with minimum 6-inch separation.
- JJ. Do not fasten boxes to ceiling support wires or other piping systems.
- KK. Provide blank covers or plates for all boxes that do not contain devices.
- LL. Use protective plastic bushings or insulated throat bushings at each raceway termination not installed to an enclosure. Bushings shall be threaded to the raceway end or connector.
- MM. Use conduit bodies to make sharp changes in direction, such as around beams. "Goosenecks" in conduits are not acceptable.
- NN. Paint all exposed conduit to match the surface to which it is attached or crosses. Clean conduit prior to painting in accordance with paint manufacturer's instructions. Where raceway penetrates non-rated ceilings, floors and walls, provide patching, paint and trim to retain architectural aesthetics similar to surroundings.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment.
 - a. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."
6. Damage to existing underground utilities shall be repaired immediately by the Contractor at no cost to the Owner.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Comply with NFPA 70E Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

B. Equipment Identification Labels:

1. Nameplate, black letters on a white field, with the following information.

a. Switchboards and Panelboards:

- 1) Equipment designation.
- 2) Source from which equipment is fed.
- 3) Voltage, phase and wire configuration.
- 4) AIC rating.

b. Disconnects, Starters or Contactors.

- 1) Load served.
- 2) Panelboard circuit number from which device is fed.
- 3) Fuse or circuit amperage and poles. Where fused disconnect is installed, denote the maximum fuse size to be installed.

c. Control or Low-Voltage System Panels

- 1) Equipment designation
- 2) System description (fire alarm, intercom, security, etc.)
- 3) Panelboard and circuit number from which panel is fed, if applicable.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:

- a. 1-1/2 by 6 inches for raceway and conductors.
- b. 3-1/2 by 5 inches for equipment.
- c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - d. Red, 6-inch wide, suitable for conductive or inductive tracing for locates.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.

2.6 SIGNS

- A. Baked-Enamel Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch grommets in corners for mounting.
 3. Nominal Size: 7 by 10 inches.
- B. Metal-Backed Butyrate Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal Size: 10 by 14 inches
- C. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
 2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. 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 and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Service Disconnect Nameplate: Provide nameplate on service disconnect that reads "SERVICE DISCONNECT".
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage.
- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
- O. Self-Adhesive Labels:
 - 1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- V. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
 - 2. Install underground-line warning tape for cables in raceways.
- W. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- X. Metal-Backed Butyrate Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- Y. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- Z. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.

3.2 IDENTIFICATION SCHEDULE

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

- E. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- F. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated.
- G. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- H. Arc Flash Warning Labeling: Self-adhesive labels.
- I. Equipment Identification Labels:
 - 1. Indoor Equipment: Baked-enamel signs.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work specified in this section.
- B. Related Requirements:
 - 1. Section 019100 – General Commissioning Requirements
 - 2. Section 260500 – General Provisions for Electrical Systems
 - 3. Section 260553 – Identification for Electrical Systems

1.2 SUMMARY

- A. Provide a Code Compliant Automatic Networked Lighting Control System for interior lighting as indicated on plans and outlined in this section.
 - 1. Control Devices under this section are shown diagrammatically on the drawings and additional Class 1 and/or Class 2 wiring may be required for a complete system. Class 2 wiring may be required in addition to the system network cable (i.e. 0-10V dimming circuits from control modules to lighting fixtures). It shall be the responsibility of the contractor and system vendor to determine the quantity and type of cable/wiring required for the complete and proper operation of the system. System design is based upon intelligent controls and/or lighting fixtures interconnected with network control cables (exception: Small spaces, such as private offices, where occupancy based control can be accomplished with one wall switch type occupancy sensor, to be provided by the same manufacturer). Control devices shall also be provided for automatic, occupancy based control of receptacle/plug loads where designated on the drawings. Control devices for controlled receptacles shall be compatible with, and connected to, the local lighting control network bus in each space. Controlled receptacles shall function to turn 'OFF' when the local occupancy/vacancy sensor (or sensors) in that space has detected vacancy for the specified time period. Receptacles that are connected to an automatic control device shall be clearly indicated with the industry standard icon for controlled plug loads.
 - 2. It is the electrical contractor's responsibility to include all material, labor and programming to provide a complete and properly working system that complies with listed sequences of operation and control zones indicated on the drawings.
 - 3. Proper product adjustment, testing, training and commissioning coordination shall take place in compliance with this document as well as applicable energy codes and listed sequences of operation.
- B. Exact configuration, wiring methods, and system topology may vary by manufacturer. The contractor proposing the substitution shall be responsible for all wiring and system components necessary to provide a complete system that functions as designed to meet the specified sequence of operation. The contractor shall be responsible for cost associated with any necessary re-design to the construction documents required for rough-in and installation. All substitutions are contingent on shop drawings, to be provided prior to system pre-installation meeting. Shop drawings shall include detailed information regarding manufacturer's recommendations for wiring methods, sensor placement, topology, and other system requirements.

1.3 SPECIAL SPECIFICATION AND OPERATION

- A. The lighting control system specified in this section shall provide a combination of time-based, sensor-based (both occupancy and daylight), and/or manual lighting control.
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Dimmable lighting that is not in a daylight zone shall be manually dimmed from the associated control station(s) in the room. Dimmable lighting in daylight zones shall be automatically dimmed, with manual over ride control as described in this specification section and the sequence of operation for the applicable room requirements.
- C. All system devices shall be individually addressable and shall be networked together via network control cable to enable digital communication. Contractor to verify cable type and wiring topology required by manufacturer.
- D. Individual lighting zones shall be capable of being segmented into sufficient channels of occupancy, photocell, and switch functionality to comply with advanced configurations and sequences of operation. Daylight zones and switched zones may differ in some spaces. System shall be capable of automatically controlling dimmed daylight zones independently of switched zones.
- E. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function or global functionality as necessary to meet all sequences of operation.
- F. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.
- G. Time of day capabilities must meet local code requirements or at a minimum a 10 hour backup, astronomic time function and Holiday function.
- H. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via the CAT5 network as required to alter time delays, disable/enable functions, remotely monitor activity, etc.
- I. The system architecture shall facilitate remote operation via a computer connection.
- J. Networked interior distributed lighting controls shall consist of lighting control modules, relays, and associated input devices that operate in default capacity even if network connectivity to the greater system is lost. (Note: control modules may be integrated into light fixture as an “intelligent” light fixture.)
- K. Occupancy based controls shall consist of Passive Infrared or dual-technology occupancy sensors connected via network control cable in larger, multi-zone spaces such as classrooms. In small offices, occupancy based controls shall include dual technology, single or multi-zone wall switch type occupancy sensors.
 - 1. Dual technology sensors shall consist of Passive Infrared as a primary technology and Microphonic or Ultrasonic as a secondary technology.
 - 2. Occupancy-based controls for interior lighting shall provide automatic shut-off control as indicated for manual-on or automatic-on lighting as designated by code or sequence of operation.

3. Sensors covering 1 lighting zone with 1 lighting level shall be manual on, auto off. Where multiple lighting levels are indicated (bi-level control), sensors shall be auto on to 50%, manual on to 100%, auto off.
 4. Occupancy sensors shall provide complete and proper volumetric coverage of each room within the coverage limits of the devices provided, in accordance with the manufacturer's published coverage limits. Unless otherwise indicated, the coverage pattern shall provide detection of desk activity (hand motion) for over 90% of the room area minimum, as required to accommodate all occupancy habits of single or multiple occupants at any location within each room.
 5. Wall switch occupancy sensors, shall include means for manual adjustment. Sensors shall have adjustable sensitivity and time-delay settings, which shall be adjusted in each room to suit the actual room conditions. The occupancy sensors shall be adjusted such that the presence of one occupant within sight of the sensor is sufficient to keep the controls from automatically shutting off the lighting, with sufficient time-delay to allow an occupant to conduct any normal functions that may be out of sight from the sensor. Sensors covering 1 lighting zone with 1 lighting level shall be manual on, auto off. Where multiple lighting levels are indicated (bi-level control), sensors shall be auto on to 50%, manual on to 100%, auto off. Normal air movement while the room is unoccupied shall not in itself cause the occupancy sensors to remain activated. Sensor/Switches shall be provided with a button for each designated zone of control (or light level with rooms requiring bi-level switching).
 6. Occupancy-based controls shall include auxiliary contacts for interface with the energy management or building automation system for HVAC system control, in accordance with the requirements of Section 230923. Refer to mechanical plans for required auxiliary contact requirements. Auxiliary contacts may be housed in a network control device, and not the occupancy sensor itself.
- L. Wall Control Stations (other than wall type, stand-alone occupancy sensor switches) shall be Class 2 devices networked with control cable and shall include on/off/dim or scene functions to initiate the proper sequence of operation for the space.
- M. A networked UL 924 compliant emergency control device shall be used that monitors a switched circuit providing normal lighting to an area, and an un-switched normal circuit. The unit provides normal ON/OFF/Dim control of emergency lighting along with the normal lighting (ON/OFF control is monitored by the switched monitor circuit). Upon normal power failure (loss of power to un-switched circuit), the emergency lighting circuit will close, forcing the emergency lighting ON and FULL if dimmed until normal power is restored. Upon restoration of normal power, lighting shall function as specified in default mode, which includes dimming and daylight harvesting.
- N. A control device shall be provided for receptacles/plug loads that are designated to have occupancy based automatic control on the drawings. The control device shall be rated for 20A, and be compatible with, and connected to the local lighting control network in each space via CAT-5E network cable. Control devices for receptacle/plug loads shall be programmed by default to be 'ON' whenever the local occupancy sensor detects occupancy in the room, and to turn 'OFF' after the sensor has detected vacancy for 15 continuous minutes. Control devices shall be installed in concealed, accessible locations, and be labeled with the circuit number for which they are installed.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of automatic lighting control device and equipment provided on the Project, up-dated to record changes.

- B. Shop Drawings: Layouts of photocells, occupancy sensors, and network devices necessary for a complete working system. Provide wiring diagrams showing the connection of all system parts, and showing all necessary electrical provisions to accommodate the intent of the design. Layouts of devices and wiring topology to be shown on project lighting plans, and supplemented with one-line wiring diagrams describing complete network configuration and topology.
- C. Installation and Start-up Instructions: Manufacturer's installation and start-up instructions. Submit to the Commissioning Authority with a copy to the Architect.
- D. Commissioning Notification: Written notification of the proposed date for performing commission activities. Submit to the Commissioning Authority with a copy to the Architect.
- E. Test Reports: Record of all field test data. Submit to the Commissioning Authority with a copy to the Architect.
- F. Training Documentation: Sign-off form and attendee sign-in sheet for the training session. Submit to the Commissioning Authority with a copy to the Architect.
- G. Meeting Minutes: For pre-installation meeting.
- H. Contractor shall initiate and schedule a pre-installation meeting with manufacturer's and owner's representative.

1.5 OPERATING AND MAINTENANCE MANUALS

- A. Submittals: Information submitted for review, up-dated to record any changes.
- B. Operating Instructions: Supply a detailed narrative description of the operation of the lighting controls. Indicate application conditions, limitations of use, coverage patterns and adjustments. Include manufacturer's installation instructions.
- C. Maintenance Instructions: List replacement parts, including source. Indicate recommended maintenance and testing procedures and intervals. List all individual system components that require periodic maintenance. Include a service directory with names and telephone numbers to obtain service.
- D. Warrantee: Manufacturer's warranty certificate.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials for complete system shall be provided per manufacturer to meet the performance criteria in this specification, and the sequence of operation for each space. Refer to the lighting control devices schedule for additional information on specific products and intended sequence of operation.
- B. Wall Switch Occupancy Sensors: Decora style wiring device shall include "off" and "auto" controls, a dual technology, passive infrared/ultrasonic occupancy sensor and an indicator light that illuminates when the sensor detects occupancy. The sensor shall have a high-density 180° coverage pattern that detects walking motion within 7.5 m (24 ft.) in front of the device and 3.0m (10 ft.) to either side when mounted 1.2 m (4 ft.) above the floor. The

device shall be arranged for manual control to switch lights on, and automatic control to switch lights off. Sensors shall have adjustable sensitivity (minimum to maximum) and time delay (30 seconds to 30 minutes) settings. Sensors shall initially be set at maximum sensitivity and 15 minutes delay. The device shall be rated for control of up to 800 Watts of load at 120 VAC. The device shall allow no leakage to load when in the "off" mode, and shall have no minimum load requirement. Wall switch occupancy sensors shall be equivalent to the following based on type of control specified: Type DW: Manual ON, Automatic OFF Wall switch type dual technology, passive Infrared and ultrasonic occupancy sensor with built-in override control (off-auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; To be furnished by manufacturer of complete distributed lighting control system.

2.2 WIRE AND CABLE

- A. General: Wire size shall be minimum #12 AWG, except low-voltage control cable. Power and grounding conductors shall be minimum #12 AWG. Cable shall be rated CL2 where installed in conduit. Cable run open air shall be CL2P, plenum rated.
- B. Network cable: to be provided per manufacturer's requirements. Network cable shall be white.
- C. Low-Voltage Control Cable: #16 AWG, multi-conductor cable with jacket to match color of network cable, except as otherwise indicated. Quantity of conductors as required for connected devices. Dimming control cabling (0-10V) shall be installed in raceway (1/2" EMT), except where installed above an accessible ceiling. All cable in plenum spaces shall be plenum rated.

2.3 MANUFACTURERS

- A. Acceptable manufacturers shall be as listed above, and as follows.
 - 1. All network control devices: Acuity nLight, or prior approved equivalent. See Part B of this paragraph.
 - 2. Cable: Belden, Canare, West Penn, or as specified by the manufacturer.
- B. Substitutions may be considered only when submitted in conformance with Section 260500, and explicitly approved by the Engineer and Owner.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to beginning rough-in for the automatic lighting controls, The Electrical Contractor shall arrange a pre-installation meeting on the site between all parties involved in the automatic lighting control system installation, including the Electrical Systems Installer, the manufacturer's Factory Authorized Representative and the Owner's Representative. All parties shall review the automatic lighting control shop drawings, the manufacturer's installation instructions, applicable regulations and any site conditions pertinent to installation of the automatic lighting controls. Verify placement of sensors and installation criteria.

- B. The Electrical Contractor shall prepare minutes of the pre-installation meeting and distribute them to all parties in attendance at the meeting, as well as the Owner's Representative and the Architect.

3.2 INSTALLATION

- A. Install equipment in accordance with the manufacturer's instructions in the locations indicated on the Drawings. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. All Category cable shall be installed in accordance with T568B specifications.
- B. Coordinate the control requirements of all devices and sensors to insure proper operation. Provide all necessary accessories.
- C. Locate interior photocells where they are protected from direct sunlight and where they can be aimed toward the zone they are controlling. Photocells to be installed per manufacturer's recommendations, and should be closed-loop, requiring multiple sensors for rooms with multiple daylight zones and zoning per day-lighting requirements. Photocells controlling non-dimmed zones shall consider natural and artificial light, but not be in direct sunlight, or directly under a lamp source.
- D. Locate and aim occupancy sensors as required for complete and proper volumetric coverage within the range of coverage of controlled areas per the manufacturer's recommendations. Rooms shall have 90% minimum coverage to completely cover the controlled area. Coverage shall accommodate all occupancy habits of single or multiple occupants at any location within the room. The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only the minimum quantity and placement of sensors that are to be provided. Provide additional sensors if required to properly and completely cover the respective room. Locations shall be carefully selected to insure that coverage patterns are unobstructed.
- E. Contractor is to provide a sufficient quantity and layout of occupancy sensors to properly meet coverage and intended sequence of operation. Locations shall be carefully selected to insure that coverage patterns are unobstructed.
- F. Mount occupancy sensors and photocells in finished spaces according to manufacturer instructions. In unfinished spaces or where ceiling-type sensors are installed where there is exposed structure, mount the sensors in surface mounted outlet boxes.
- G. Wiring shall be arranged as shown on the shop drawings. Wiring and cable shall be installed in raceways or cable trays, except low-voltage cables run above accessible ceilings consisting of removable tiles. Raceways shall be grounded to the power system ground.
 - 1. Network control cables shall connect control devices in uninterrupted continuous runs without intermediate splices. Cables shall be free from shorts or ground and shall be tested.
 - 2. Cables shall be routed so as to maintain a separation of at least 610 mm (24 in) from all heat sources and from ballasts, transformers, dimmers and other sources of electromagnetic interference. Avoid exposed cables in occupied areas or in areas where they might be damaged as a result of normal use of the area. Where two (2) or more cables run in parallel, they shall be bundled with cable ties.

3. Cables run exposed in ceiling cavities shall be supported by means of suitable cable support devices from the building structure. They shall not lie upon the ceiling, nor shall they be supported from the ceiling frame, ceiling suspension wires, conduits, pipes, ductwork or lights. Supports shall be spaced no further apart than 5 ft. on center.
4. Care shall be exercised during cable installation not to damage cable insulation. Damaged cables shall be removed and replaced. Type and spacing of supports shall ensure that cable will not kink or sag.
5. In each cable that terminates at a ceiling device, provide 305 mm (12 in) of slack cable, neatly coiled, to facilitate future modifications. Terminations shall be made in a neat and workmanlike manner, and in accordance with Section 271500.
6. Terminate the manufacturer's recommended cable type to the appropriate termination point (RJ45 jack, etc.).
7. Cabling for 0-10V dimming control shall be installed in raceway (1/2" EMT), except where installed above accessible ceiling. Cabling for 0-10v dimming control shall be Class 2 and separate from any line voltage wiring. Raceway shall be installed orthogonal to room surfaces, and be concealed by structure wherever possible.
8. Networked control cable shall be run orthogonal to room surfaces, be routed along edges of rooms and concealed by structure wherever possible. Network cable shall be installed in raceway (1/2" EMT) in exposed or open ceilings and may end when cable reaches cable tray or accessible ceiling space. Electrical Contractor to record and provide identification of control devices (Device ID #'s) in each space per manufacturer instructions. All power packs and control devices shall be labeled with the corresponding circuit number, and locations shall be documented on as built drawings.

3.3 ADJUSTMENT, TESTING, DEMONSTRATION & COMMISSIONING

- A. Notify the Owner's Representative and the Commissioning Authority at least two (2) weeks in advance of the date of each test, to allow witnessing of the tests.
- B. The automatic lighting control devices are subject to commissioning. The Electrical Contractor shall assist the Commissioning Authority with scheduling and coordinating commissioning activities, developing commissioning test procedures, conducting commissioning tests, preparing commissioning documentation, and developing a training plan in accordance with specific responsibilities as assigned in Section 019100. Prior to the start of functional performance testing for commissioning purposes, complete all start-up and checkout procedures and verify that the equipment is completely ready to be tested. A knowledgeable electrician in the employ of the Electrical Installer shall be present during functional performance testing for commissioning purposes.
- C. The Contractor is to supply tools, instruments, gauges, testing equipment, protective devices and safety equipment for adjustment, testing and demonstration as needed.
- D. Prior to system testing, the Electrical Contractor shall prepare a list of the devices to be tested, together with the associated location of each device and device identification (bar code number, ID, etc.). Include space to indicate test response for each device.
- E. During adjustment and testing, the Electrical Contractor shall carefully record all settings and all test results, including expected test results, actual test results, and corrective actions taken. Records shall be submitted to the Architect's Consultant and included in the Operating & Maintenance Manuals. A device settings report from applicable software is also acceptable documentation.

- F. Initial Set-up: Verify that wiring is correctly connected to each device. Adjust controls to function as specified under the sequence of operation. Settings shall comply with direction received from the Architect's Consultant and/or sequence of operation. Default to IES light levels if information is not available at time of initial set up.
- G. Program sequences of operation that include time functions to operate at times selected by the Owner's Representative. Information must be available before technician is scheduled for start-up.
- H. Field Testing: Test all system features for proper function. Tests to be performed shall include, but not be limited to, the following:
 - 1. Verify the sequence of operation for each device.
 - 2. Verify the setting and accuracy of each timing function in each device.
 - 3. Verify that each manual override control functions properly.
 - 4. Verify that occupancy sensors do not remain actuated due to normal conditions (e.g., air movement).
 - 5. Verify that occupancy sensors are actuated by hand motion within the entire area of coverage.
 - 6. Verify that occupancy sensors actuate when a person enters the area of coverage.
 - 7. Correct any deficiencies discovered as a result of the above testing, and completely retest the work affected by such corrections as part of the required installation and testing.

3.4 ON-SITE TRAINING

- A. After the system has been completed, tested and is operating properly, the manufacturer's representative shall demonstrate by actual usage, the proper operation of each system device and function in the presence of the Owner's Representative. Demonstration shall include repetition of selected field tests, as well as additional adjustment or testing required to demonstrate that the system performs in accordance with the operational description as specified herein and the Owner's operational requirements.
- B. On-site training shall be coordinated with the Commissioning Authority in accordance with Sections 019100. At least two (2) months prior to the anticipated training session, submit a draft of the training plan and the proposed participants to the Commissioning Authority for review and comment. Two (2) weeks prior to the scheduled training, submit to the Commissioning Authority a revised written training plan incorporating the Commissioning Authority's comments.
- C. The Electrical Contractor shall coordinate end user training to be conducted after the Operating and Maintenance Manuals for the project are completed and available for use during the training session.
- D. An authorized factory representative shall conduct two (2) hours minimum of training for the Owner's maintenance personnel in the operation and maintenance of the lighting controls and applicable software. Training time shall be extended as necessary to satisfy the Owner's Representative that all pertinent topics have been adequately covered.

- E. The Electrical Contractor shall maintain a training sign-in sheet, upon which participants in the training session, including the instructors, shall record their names. The training sign-in sheet shall be dated.
- F. On-site training shall follow a written training plan, prepared in advance. The training plan shall outline the topics to be covered, the publications to be used, and the training schedule.
- G. The training shall be conducted by technicians who are thoroughly familiar with the equipment and its features, and also with the Project. The training shall include instruction, field demonstration, and over-the-shoulder hands-on exercises. As a minimum, the training shall cover, but not be limited to, the following topics:
 - 1. General overview of lighting controls, including purpose and principle of operation.
 - 2. Location of lighting control components.
 - 3. Interpretation of equipment output devices, such as indicators and status contacts.
 - 4. Control adjustments and settings.
 - 5. Operation of system controls, including over-ride switches.
 - 6. Recommended maintenance procedures and intervals.
- H. At the conclusion of the training session, the Electrical Contractor shall obtain written sign-off from the Commissioning Authority and the Owner's Representative. Insert a copy of the sign-off form and the training sign-in sheet into the Operating and Maintenance Manuals. Submit another copy of the training sign-in sheet to the Architect.

END OF SECTION 26 0923

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for SPD as installed in panelboard.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

A. Typed panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 3R.
 2. Height: 84 inches maximum.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- E. Incoming Mains Location: Convertible between top and bottom.
- F. Phase, Neutral, and Ground Buses: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Compression or Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 3. Ground Lugs and Bus-Configured Terminators: Compression or Mechanical type, with a lug on the bar for each pole in the panelboard.
- H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices as noted on the drawings.

- J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; by Schneider Electric.
 - 2. GE.
 - 3. Substitutions: Under provisions of Division 01.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Hinged, secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: As indicated on drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
 - 5. Substitutions: Under provisions of Division 01.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As indicated on drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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

1. Square D; by Schneider Electric.
2. Substitutions: Under provisions of Division 01.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

- a. Inverse time-current element for low-level overloads.
- b. Instantaneous magnetic trip element for short circuits.
- c. Adjustable magnetic trip setting for circuit-breaker frame sizes 225 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic Trip Circuit Breakers:

- a. RMS sensing.
- b. Field-replaceable rating plug or electronic trip.
- c. Digital display of settings, trip targets, and indicated metering displays.
- d. Multi-button keypad to access programmable functions and monitored data.
- e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
- f. Integral test jack for connection to portable test set or laptop computer.
- g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).

6. MCCB Available Features and Accessories:

- a. Standard frame sizes, trip ratings, and number of poles.
- b. Breaker handle indicates tripped status.
- c. UL listed for reverse connection without restrictive line or load ratings.

- d. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
- e. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover. Circuit directory shall be typed and dated with month and year that circuit directory was provided.
- D. Where more than one nominal voltage is present on the premises, the conductor color-coding legend shall be permanently posted at each branch circuit and distribution panelboard.
- E. All panelboards shall have signage for arc hazard installed. The marking shall be located to be clearly visible to qualified personnel before examination, adjustment, servicing or maintenance of the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Mount top of trim 78 inches above finished floor, or the height of the panelboard, unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
- G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

H. Install filler plates in unused spaces.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers 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.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Straight-blade convenience receptacles.
2. GFCI receptacles.
3. Controlled receptacles.
4. Toggle switches.
5. Wall switch sensor light switches with dual technology sensors.
6. Wall plates.

1.2 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
3. Leviton: Leviton Mfg. Company, Inc.
4. Pass & Seymour: Pass& Seymour/Legrand.

1.3 ACTION SUBMITTALS

- #### A. Product Data: For each type of product.
- #### B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.4 INFORMATIONAL SUBMITTALS

- #### A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- #### A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- #### A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- #### B. Comply with NFPA 70.
- #### C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2. Devices shall comply with the requirements in this Section.

- D. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

2.3 GFCI RECEPTACLES

- A. General Description:

1. 125 V, 20 A, straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

2.4 CONTROLLED RECEPTACLES

- A. Provide controlled receptacles with the word “controlled” and power symbol on device face per NEC 406.3(E).

2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A.

2.6 WALL SWITCH SENSOR LIGHT SWITCH, DUAL TECHNOLOGY

- A. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology.
1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for LED lighting, and 1/4 hp at 120-V ac.
 2. Integral relay for connection to BAS.
 3. Adjustable time delay of 15 minutes.
 4. Able to be locked to Automatic-On or Manual-On mode.
 5. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
 6. Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.7 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Stainless Steel, smooth, type 302.
 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 and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

- A. Device Color:
 1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 1. Protect installed devices and their boxes. 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 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 and painting is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until right 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.
- D. Device Installation:
 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
 10. Provide labeling on faceplate of each receptacle device for panel and circuit serving the device.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- H. GFCI Receptacles: Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.2 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Perform the following tests and inspections:
1. Tests for Convenience Receptacles:
 - a. Line Voltage: Acceptable range is 105 to 132 V.
 - b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - c. Ground Impedance: Values of up to 2 ohms are acceptable.
 - d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - e. Using the test plug, verify that the device and its outlet box are securely mounted.
 - f. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. 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. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. Verify voltage requirements with drawings.
 - 4. 240 or 600-VAC.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. 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.

2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
 - 5. Substitutions: Under provisions of Division 01.

- B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Three Pole, 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.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish:
 - 1. Dry Interior Locations: NEMA 250, Type 1, finished with gray enamel paint.
 - 2. Wet or Exterior Locations: NEMA 250, Type 3R, finished with gray enamel paint.
 - 3. Kitchen Locations: NEMA 250, Type 4X, stainless steel.
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts.
- D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1)] or directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250, Type 4X stainless steel shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Indoor/Outdoor locations subject to water spray: NEMA 250, Type 4X.

4. Kitchens: NEMA 250, Type 4X Stainless Steel.

3.2 INSTALLATION

- 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. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.
- F. Set field-adjustable circuit-breaker trip ranges to values indicated on the Drawings.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections
- B. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

- 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- h. Verify correct phase barrier installation.
- i. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
 1. Test procedures used.
 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 3. List deficiencies detected, remedial action taken, and observations after remedial action.
- E. Inspect and test in accordance with NETA ATS.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of this Contract, including General and Supplementary Conditions and Division 1 specifications, apply to work specified in this section.
- B. Related Sections:
 - 1. Section 260500 – General Provisions for Electrical Systems.
 - 2. Section 260526 – Grounding & Bonding: Requirements for bonding.
 - 3. Section 260529 – Hangers and Supports: Luminaire support requirements.

1.2 SUMMARY

- A. Provide luminaires, including emergency lighting and exit signs, at all interior locations indicated on the Drawings.
- B. Provide luminaires at all exterior locations indicated on the Drawings. Provide lighting poles where indicated.
- C. Adjust and aim luminaires and verify proper operation.

1.3 DESCRIPTION

- A. Luminaires shall be complete with trim, mounting hardware, drivers and LED modules, and shall be suitable for the location in which they are installed.
- B. Provide all materials required to entirely complete each luminaire ready for use, in accordance with the conditions and requirements of the building construction.

1.4 WARRANTY

- A. In addition to the warranty specified in the General Conditions, each manufacturer of electronic lighting components shall warranty the electronic ballasts and LED drivers to be free from defects in materials and workmanship. This additional warranty shall extend for a period of at least five (5) years from the date of manufacture or purchase. For items covered by such warranty, the effective date shall in no case be more than two (2) years prior to the final date of Substantial Completion for the Project. The warranty shall cover the full cost of repairing all the components or furnishing replacements in kind. The warranty shall not be pro-rated and there shall be no deductible amount. Include warranty certificate in the Operating and Maintenance Manuals.

1.5 SUBMITTALS

- A. Product Data: Specific product data shall be provided for each type of luminaire, light pole, driver, LED module provided for interior and exterior lighting on the Project. Include physical description, materials and finishes, dimensions, weights, accessories, photometry data and efficiency data, as applicable. Product data shall also include documentation indicating that all LED systems are provided and tested in accordance with IES LM-79 and LM-80. Submittal data must include documentation that the light engine and driver electronics have been tested as a system and UL listed for the application for which they are being installed.

- B. Shop Drawings: Outline drawings and fabrication details for each custom-fabricated luminaire type provided on the Project, indicating dimensions, weights, methods of field assembly, components, features, and accessories. Wiring diagrams for “master/slave” tandem wired luminaires.
- C. Test Reports: Record of all field test data.
- D. Training Documentation: Sign-off form and attendee sign-in sheet for the training session. Documentation shall also be provided to record meeting minutes of lighting and controls pre-installation meeting(s).

1.6 INFORMATION FOR OPERATING & MAINTENANCE MANUALS

- A. Submittals: Information submitted for review, up-dated to record any changes.
- B. Maintenance Instructions: List replacement parts, including source. Indicate recommended and required maintenance and testing procedures and intervals. List all individual lighting components that require periodic maintenance. Identify features, accessory attachments, safety precautions, and procedures for cleaning, lamp replacement and adjustment. Include manufacturer's installation instructions. Detail trouble-shooting procedures, including step-by-step instructions for typical trouble symptoms. Detail waste disposal procedures, including recycling options, for compliance with government regulations covering the disposal of lamps containing mercury.
- C. Warranty: Electronic ballast, driver, and rechargeable battery component manufacturers' warranty certificates.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. See schedule on Drawings for listing of required luminaires. Luminaires shall be complete with trim and mounting hardware. Provide hardware for each luminaire based on the ceiling condition for which it is to be installed.
- B. All luminaires shall bear the UL label associated with the type, location, ambient temperature and usage of the individual luminaire. All luminaires shall be included with drivers that have been UL listed or recognized for use in that specific fixture. Documentation indicating UL listing(s) shall be provided with product submittals.
- C. Integral LED drivers shall be installed by the manufacturer, and supplied as a total system with the fixture housing and LED modules/boards.
- D. Custom colors shall be applied to luminaires as indicated on the luminaire schedule. Custom colors shall match color samples supplied by the Architect.
- E. Luminaires equipped with doors shall be free of light leakage around the doors under normal operating conditions. Doors shall be designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in the normal operating position. Doors shall utilize spring-loaded latches on fluorescent troffers and on other luminaires that are available with such an option.

- F. All plastic lenses shall be UV-stabilized virgin acrylic unless otherwise indicated. Flat plastic lenses shall be KSH-12 or equal and a minimum of 0.125 in thick. Prisms shall be square cut at 45°; round cut is not acceptable.
- G. All louvered luminaires shall be shipped with dust covers. Covers shall be removed after final building vacuuming has been completed.
- H. Exit signs shall be internally-illuminated. Illumination of lettering on each sign shall be diffuse, with a minimum luminance of 8.6 candela/m² (2.5 foot-lambert).
- I. LED luminaires are to be coordinated with the lighting control system, and supplied with all necessary components to produce a fully functional system. Components may vary based on the lighting control approach of the relevant manufacturers. (i.e. The lighting control manufacturer can supply all control equipment and devices to be external of the lighting fixtures. However, some systems that are approved for bid accommodate fixtures with integral components that can be connected to the digital distributed lighting control system). See section 260923 – Distributed Lighting Control.

2.2 DRIVERS

- A. Each luminaire shall be provided with a driver of one of the types specified herein, suitable for operation of the indicated lamp type. Driver voltage rating shall be selected to match circuit voltage.
- B. The wiring to each LED driver shall be equipped with push-in ballast disconnect plugs. Line-side terminals of disconnect plugs shall be guarded. Disconnect plugs shall be located within the driver compartment.
- C. LED Drivers: LED drivers to be between 300mA and 1000mA as indicated by specification information in the luminaire schedule or as required by the manufacturer of each specified product. Each driver to be tested with LED module for which it is installed per IESNA LM-79 and LM-80 certification standards, and the entire fixture/driver/light engine assembly shall be UL listed (all documentation regarding fixture assembly UL listing is required to be included with the fixture submittal package). LED drivers to be supplied by luminaire manufacturer, and supplied with the fixture as a tested and certified system.
 - 1. LED drivers shall be available for voltages listed on drawings.
 - 2. LED drivers shall be provided with 0-10V dimming capabilities in all areas with dimming/daylighting harvesting controls.
 - 3. LED luminaires indicated as emergency lights on drawings shall be compatible with emergency battery packs that support LED, to be provided by the fixture manufacturer.

2.3 LAMPS

- A. All luminaires shall be complete with LED.
- B. Light-Emitting Diode (LED):
 - 1. White LED Lamps: Projected rated life shall be 60,000 hours, at 85% lumen output (minimum).
 - 2. Colored LED Lamps: Rated 50,000 hour life minimum.

3. Led to be driven at nominal drive current for the specified output (300mA-1000mA range) and tested with LED driver as a complete system for which it is installed per IESNA LM-79 and LM-80 certification standards.
4. LEDs used in general lighting applications to utilize phosphor technology.
5. LED color temperature and binning to be within a 3-step MacAdam ellipse.

2.4 ACCEPTABLE MANUFACTURERS

- A. Manufacturers of luminaires shall be as indicated on the luminaire schedule.
- B. Manufacturers of drivers shall be as follows:
 1. Driver disconnect plugs – Ideal “Power-Plug” Series.
 2. LED Drivers – Phillips Advance, OSRAM, EldoLED, or as provided/recommended by luminaire manufacturer. All driver information for alternate manufacturers to be provided in lighting submittal package.
- C. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install luminaires in accordance with the manufacturer's recommendations and installation details.
- B. Provide backboxes matched to luminaires. Where luminaires are suspended from ceiling grids, provide special interface outlet boxes designed to mount on grid members and facilitate power cable interface at the suspension point canopy, such that the power cable neither lies exposed above the ceiling nor runs in raceway. In other locations, where luminaire manufacturer's installation instructions indicate use of standard outlet boxes, boxes shall be in accordance with Section 260533. Back boxes shall be plumb and perfectly aligned.
- C. Installation of custom luminaires shall be coordinated between architect, engineer, contractor, and manufacturer before installation or rough-in or luminaire assemblies or series of luminaire assemblies. Where isometric drawings of fixture assemblies were included in documents, shop drawings shall be provided by the manufacturer and reviewed by architect and engineer prior to installation. Contractor to schedule pre installation meeting with all parties before installation of custom detailed fixtures are installed.
- D. Mount interior luminaires at locations indicated on the drawings. Support luminaires in accordance with Section 260529, in the following manner:
 1. Mount suspended stem supported luminaires on swivel hangers where required which are a standard catalog item of the same manufacture as the luminaire. Support from fixture stud, or as otherwise recommended by the manufacturer. For linear luminaires, provide one more hanger than the number of luminaires in the row. Coordinate degree of swivel with the ceiling slope. Other suspension methods may be considered in mechanical type rooms where approved by Architect's Consultant.
 2. Mount suspended aircraft cable supported luminaires on canopies which are a standard catalog item of the same manufacture as the luminaire. Support from ceiling grid where

- applicable, or as otherwise recommended by the manufacturer. For linear luminaires, provide one more hanger than the number of luminaires in the row.
3. Mount suspended chain supported luminaires on hangers which are a catalog item of the same manufacture as the luminaire. Support from building structure as recommended by the manufacturer. For linear luminaires, provide one more hanger than the number of luminaires in the row.
 4. Mount surface and wall luminaires square with the room. Support from fixture stud or as otherwise recommended by the manufacturer. Attach surface luminaires at two (2) support points, minimum. Provide 38mm (1½ in) metal spacers for luminaires which occur on combustible ceilings. Submit spacer for approval.
 5. Install recessed luminaires in suspended acoustical ceiling systems in accordance with the provisions of ASTM C636. Verify all ceiling types and ceiling thicknesses to ensure that recessed luminaires can be properly installed. Provide plaster frame mounting kits where recessed luminaires are to be installed in hard ceilings.
- E. Mount exterior luminaires at locations indicated on the drawings. Support luminaires in accordance with Section 260529, in the following manner:
1. Mount surface and wall luminaires square with the building lines. Support from fixture stud or as otherwise recommended by the manufacturer. Attach surface luminaires at two (2) support points, minimum.
 2. Install recessed luminaires in exterior soffits in accordance such that luminaire weight is supported by structural members. Verify soffit material and thickness to ensure that recessed luminaires can be properly installed.
- F. Verify all measurements. Luminaires must fit in place in a regular, trim and workmanlike manner, to the satisfaction of the Architect's Consultant. Verify the type of ceiling system in every room or space to ensure that the luminaires are compatible before releasing orders for luminaires. Incorrectly ordered luminaires shall be replaced, with no additional compensation.
- G. Verify luminaire locations with the Architectural reflected ceiling plans and interior wall elevations, when such plans and elevations are included in the Contract Documents.
- H. All recessed luminaires installed in accessible ceilings shall be connected by means of a flexible raceway or fixture whip which is attached to a 100 mm (4 in) square junction box. Box may serve more than one luminaire.
- I. Provide bonding connections in accordance with Section 260526 and manufacturer's installation instructions.
- J. After installation, all visible labels shall be removed from luminaires.
- K. Immediately prior to occupancy, clean reflectors, aperture plates, lenses, louvers, luminaire housings and decorative elements. To prevent static buildup on lenses and reflectors, clean with a manufacturer's recommended water-diluted solution of glass cleaner and allow to air-dry after installation.
- L. Broken or defective parts shall be replaced, with no additional compensation.

3.2 ADJUSTMENT & TESTING

- A. Notify the Owner's Representative at least two (2) weeks in advance of the date of each test, to allow witnessing of the tests.
- B. Supply tools, instruments, gauges, testing equipment, protective devices and safety equipment for adjustment and testing, and demonstration.
- C. During adjustment and testing, carefully record all settings and all test results, including expected test results, actual test results, and corrective actions taken. Records shall be submitted to the Architect's Consultant and included in the Operating & Maintenance Manuals.
- D. Upon completion of the installation, aim all adjustable luminaires as directed by the Architect's Consultant. After adjustments are complete, measure the illumination levels at selected points to demonstrate proper distribution and coverage. Verify with the Architect's Consultant the points where illumination levels are to be measured.
- E. Correct any deficiencies discovered as a result of the above testing, and completely retest the work affected by such corrections, with no additional compensation.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, coordinated with each other, using input from installers of the items involved:
- B. Product Certificates: For each type of luminaire.
- C. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- 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.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- 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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for recessed luminaires.

2.2 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:
 - 1. Emergency Luminaires: As indicated on Drawings, connected to emergency generator.

2.3 EXIT SIGNS

- A. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
 - 1. Smooth operating, free of light leakage under operating conditions.
 - 2. Designed to permit relamping without use of tools.
 - 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.5 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach fixtures directly to gypsum board.
- F. Suspended Luminaire 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. Support with approved outlet box and accessories that hold stem and provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
- H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division 26, Basic Materials and Methods sections apply to work specified in this section.

1.2 REFERENCE STANDARDS

- A. ANSI/TIA-568.0-D – Generic Communications Cabling for Customer Premises
- B. ANSI/TIA-568.1-D – Commercial Building Communications Cabling Standard
- C. ANSI/TIA-568-C.2-1 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- D. ANSI/TIA-569-D – Telecommunications Pathways and Spaces
- E. ANSI/TIA-606-B.1 – Administration Standard for the Commercial Telecommunications Infrastructure
- F. ANSI/TIA-607-C – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- G. ANSI/TIA-862-B – Structured Cabling Infrastructure Standard for Intelligent Building Systems
- H. ANSI/TIA-942-A – Telecommunications Infrastructure Standard for Data Centers
- I. NFPA 70 – National Electrical Code (NEC)
- J. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

1.3 GOVERNANCE

- A. The Electrical Code referred to in these specifications is the National Electrical Code as currently adopted by the State of Washington. All work will be provided in strict compliance with the Electrical Code and all regulations that may apply.
- B. Where standards exist, for a particular category, products used on this project will be listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL), and be approved or listed for the intended service and application.
- C. These specifications do not undertake to repeat the requirements of codes, regulations or NRTL listing or labeling instructions. The Specifications or Drawings may require items or work beyond the requirements of applicable codes or regulations. The stricter, higher quality, greater quantity or higher cost will be allowed, and accommodations must be approved by Owner prior to procurement or installation. It is incumbent on the Installer, material and equipment suppliers to meet these specifications, applicable codes, regulations, and NRTL listing agency restrictions.

- D. The word "Manufacturer" will include the Manufacturer, the Manufacturer's Representative, the Distributor, the Fabricator, and the Supplier of the particular classification of equipment, system, product, and material.
- E. All work, equipment, and systems will be manufactured, provided, repaired, installed, and tested in accordance with the latest edition and all current amendments of the applicable publications and standards of the organizations listed below as of the date of the Contract Documents. When the Specification requirements exceed the requirements of these publications and standards the Specifications will govern:
 - 1. State Building Code (SBC)
 - 2. Building Department Inspectional Services
 - 3. American Society for Testing and Materials (ASTM)
 - 4. Underwriter's Laboratories, Inc. (UL)
 - 5. Insulated Cable Engineers Association (ICEA)
 - 6. National Electrical Manufacturers Association (NEMA)
 - 7. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - 8. American National Standards Institute, Inc. (ANSI)
 - 9. National Fire Protection Association (NFPA)
 - 10. Local Electric Code
 - 11. Department of Public Safety (DPS)
 - 12. Building Officials and Code Administrators International, Inc. (BOCA)
 - 13. Department of Labor USA. Safety and Health Regulations for Construction (OSHA)
 - 14. Energy Codes
 - 15. National Electrical Contractors Association (NECA)
 - 16. National Bureau of Standards (NBS)
 - 17. Federal Communications Commission (FCC)
 - 18. Utilities Serving Project
 - 19. Fire Department
 - 20. Americans with Disabilities Act Applications Guidelines (ADAAG)
 - 21. Accessibility Guidelines for Buildings and Facilities
 - 22. Any and all Federal, State and Local Standards, Codes and Authorities having Jurisdiction
- F. In addition, all phases of the Structured Cabling System installation will adhere to applicable Local Area Network (LAN) Specifications of the IEEE, Electronics Industry Association/Telecommunications Industry Association (TIA/EIA), and Building Industry Consulting Service International (BICSI). The entire system and all components will be **Nationally Recognized Testing Laboratory (NRTL)** certified to appropriate TIA/EIA performance rating Category, Latest ANSI/TIA/EIA Standards 455-A, 492, 568, 569-A, 570, 606, 607 and 758 (latest revisions), and ANSI/TIA TSB 67, TSB 72, TSB 75, TSB 95 plus other standards as applicable.

- G. The Installer will have available at the job site at all times one copy of the latest edition of the Electrical Code, TIA and BICSI Standards applicable to the work as specified within this document.
- H. The above requirements will not in any way limit responsibility or requirements to comply with all other codes, standards and laws.
- I. Material, equipment, enclosures, and systems will be designed for use as required to suit the conditions, exterior or interior operation, dust tight, water tight, explosion-proof, or other special types.
- J. All materials shall be purchased from Distributors authorized by system Manufacturers to sell new and unused components.

1.4 DESCRIPTION OF WORK

- A. The extent of telephone/data system work is indicated and is hereby defined to include, but not be limited to cable, cable supports, raceway, connectors, racks, cabinets, panels, wire management, device plates, backboard, grounding, firestop and miscellaneous items required for a complete, tested and operational system.
- B. Provide, install and test the complete cable and outlet system as indicated and described herein. Work includes procurement, project management, installation, labeling, termination, testing and cleanup of all cables installed under this project.
- C. Berk-Tek and Leviton approved base material list:
 - 1. A complete Category 6 unshielded twisted pair horizontal cabling infrastructure:
 - a. 4-Pair Category 6 unshielded twisted pair cabling
 - 1) Plenum
 - a) Blue: 10136226
 - 2) Non-Plenum
 - a) Blue: 10136339
 - b. Head End Termination
 - 1) 48-Port QuickPort Patch panel:
 - a) 49255-H48
 - 2) Category 6 Jacks
 - a) Standard User Locations: Black
 - i. Black: 61110-RE6
 - b) Wireless Access Points:
 - i. Green: 61110-RV6
 - c) Audio Visual and Projectors:
 - i. Blue: 61110-RL6
 - d) Intercom Clocks:
 - i. White: 61110-RW6
 - e) Cameras:
 - i. Yellow: 61110-RY6

- f) Heat Ventilation and Air Conditioning:
 - i. Orange: 61110-RO6
 - c. User End Terminations
 - 1) QuickPort faceplate with identification windows
 - a) 4-Port Ivory Plate 42080-4IS
 - i. Ivory Blank Inserts: 41084-0BI
 - 2) Surface Mount Box to be used for non-Flush mount locations
 - a) Ivory 1-Port: 41089-1IP
 - b) Ivory 2-port: 41089-2IP
 - c) Ivory 4-port: 41089-4IP
 - 3) Category 6 Jacks
 - a) Standard User Locations:
 - i. Black: 61110-RE6
 - b) Wireless Access Points:
 - i. Green: 61110-RV6
 - c) Audio Visual and Projectors:
 - i. Blue: 61110-RL6
 - d) Intercom Clocks:
 - i. White: 61110-RW6
 - e) Cameras:
 - i. Yellow: 61110-RY6
 - f) Heat Ventilation and Air Conditioning:
 - g) Orange: 61110-RO6
- D. Provide system testing, as-built drawings (redlines) of installed cables and numbering plan, Operations & Maintenance Manuals (O&M's), and processing of warranty registration with Manufacturer.
- E. Project coordination with General Contractor, Owner's Representative, and other trades before, during and upon completion of project as necessary for a well-executed project.
- F. Refer to other Master Division sections, bid proposal and project responsibilities matrix for responsibility and requirements for raceways, boxes and fittings, wiring devices (plates), and supporting devices, and other sections, as applicable.
- G. 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.
- H. Horizontal copper cabling system consists of four twisted pairs of solid annealed copper. Each four-pair cable is terminated onto 8 position 8 conductor ("RJ45", or 8P8C) connectors (jacks) using Insulation Displacement Conductors (IDCs). Color-coded connectors are placed into NEMA rated faceplates at the work area and placed into corresponding rack-mounted patch panels in the equipment / networking rooms. The jacks use state-of-the-art techniques to effectively eliminate Alien Crosstalk.

- I. Horizontal cabling may contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
- J. Bridged taps and/or splices will not be installed in the horizontal cabling.
- K. Communications cables shall be rated CMR or CMP. CMP cable ratings are required for cables passing through or contained within plenum air handling spaces, such as above drop ceilings and return or supply air shafts. The contractor is responsible for installing the correct cable type in the appropriate environment, and any failures to do so per Owner or the Authority Having Jurisdiction (AHJ) will result in the contractor removing the unsuitable cable and installing the correct cable, at their own expense.
- L. The maximum allowable horizontal cable length installed in the permanent link (jack to jack) is 295 feet (90 m). This maximum allowable length does not include an allowance for patch cords, maximum length of 16 feet (5 m) to the workstation equipment and of 16 feet (5 m) in the horizontal cross-connect.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide a complete data cabling and device system as described herein.
- B. Work area connectors shall be of a non-proprietary "Keystone"-style port configuration, such that they fit into all furniture, panels, wall plates, raceways, floor monuments, poke-throughs and AV boxes without adapters. Maximum density of 6 outlets shall be available in Decora footprint where required.

2.2 ACCEPTABLE MANUFACTURER SOLUTIONS:

- A. Subject to compliance with requirements, provide products of the following:
 - 1. Leviton Manufacturing Co, Inc.
 - 2. Berk-Tek, a Nexans Company
 - 3. No Substations allowed unless pre-approved in writing by Owner's IT Operation Manager Glenn R. Whitcomb 90 days prior to bid

2.3 UTP PIN/PAIR TERMINATION ASSIGNMENT

- A. The UTP cabling system will have TIA/EIA T568B pin/pair termination assignment. All conductors provided will be properly and consistently terminated at both ends throughout the entire systems. Maintain proper untwist of pairs and removal of jacket per TIA, BICSI, and Manufacturer's recommendations.
- B. Category 6 Unshielded Twisted Pair (UTP) Systems
 - 1. Category 6 UTP 24AWG copper cabling system shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords.
 - 2. Basis of Design is Berk-Tek Leviton Technologies CX6050 Category 6 UTP System.
 - 3. Category 6 Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N
3%	3 dB	3 dB	3 dB	5 dB	2 dB	3 dB	5 dB

2.4 HORIZONTAL CABLING SYSTEMS

A. CATEGORY-RATED DATA CONNECTORS (RJ45 JACKS)

1. Provide modular-type, information connectors/outlets (jacks) for 24-23 AWG copper cable. These connectors shall be individual snap-in style, and exceed compliance with TIA-568 specifications. The connectors shall comply with the following:
 - a. Shall be 8-position 8-conductor (8P8C) "RJ45"-style modular jack, Category 6, with IDC terminals, T568A/B wiring scheme (use T568B).
 - b. Shall be encased in a die-cast housing to protect from potential EMI/RFI, and utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products.
 - c. Category 6 Connectors shall exceed all component performance requirements for Category 6 in the ANSI/TIA-568-C.2 standard, as well as Class E requirements as described in ISO/IEC 11801, from 1 MHz to 250 MHz.
 - d. Shielded connectors shall utilize the same form factor, design, and tool-less installation process as the unshielded connectors in the product line.
 - e. Shall be tested by an Independent testing body such as Intertek (ETL) for component compliance (i.e. "Component rated") to ANSI/TIA-568 and for POE+ applications. Test results shall be published and publicly available without special request.
 - f. Shall be in compliance with all National Electrical Codes; compliant with ANSI/TIA-1096-A (formerly FCC Part 68); UL Listed.
 - g. When used in the plenum spaces, shall be plenum-rated per UL 2043, and all plastic components shall be made of high-impact, fire-retardant plastic rated UL 94V-0.
 - h. Shall have a maximum depth of 1.31".
 - i. Cable shall be terminated by the use of a snap-on wire manager that holds individual conductors in place during termination, and allows for termination without a complete untwist of each conductor pair. Cables shall terminate onto jack via a "clamshell" closure at rear of connector, affixing termination manager to connector IDC
 - j. Shall be terminated without the need for any punch down tool or other specialized or proprietary termination tool.
 - k. Shall be reusable and support a minimum 20 termination and re-termination cycles and be facilitated by simple termination release levers.
 - l. Shall utilize a method of line tensioning using polymer springs above the tines ("Retention Force Technology" or similar functionality) that prevents six-position modular plug insertion from damaging either the cord or the module and promotes return of tines to original position.

- m. Shall fit the full manufacturer's range of telecommunications faceplates, outlets, and field-configurable patch panels. No separate product line or style of connectors shall be required for patch panels, faceplate, biscuit, furniture, raceway and/or floor feed applications.
- n. Shall be available in 13 TIA 606-B compatible colors and supplied with interchangeable icons (Voice, Data, A/V, and blank, color coded to match the connector face) for easy identification and tracking of data, voice, or other functions. Additional bulk Icons for the connector shall be available separately.
- o. Shall be available with an optional internal shutter to protect against dust and debris such as in above-ceiling and in-floor locations.

B. PATCH PANELS

- 1. Telecommunications Room Patch panels shall be manufactured with industry-standard modular non-loaded jack type and shall hold 48 Category 6 terminations. Panels shall be:
 - a. All 48 ports.
 - b. Mount in a 2RU space.
 - c. Shall be sized to fit an EIA standard, 19-inch relay rack and hole pattern.
 - d. Shall come blank so the appropriate colored jacks can be installed.

C. FACEPLATES

- 1. Faceplates (wallplates) secure information outlets to the work area. Contractor shall provide and install single gang faceplate kits to house all jacks as required for all work area outlets, workstation base feeds, and furniture openings. Unused telecom backboxes shall receive a solid blank faceplate. Telecommunications faceplates shall:
 - a. Utilize a keystone-type ("QuickPort") footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.
 - b. Plastic and match the color of the power wiring device plates.
 - c. Support any connectivity media type, including AV and copper applications.
 - d. Have printable designation labels for circuit identification together with a clear plastic cover.
 - e. Be available in single-gang and double-gang configurations.
 - f. Have surface-mount boxes and standoff rings available for both single and double gang faceplates.
 - g. Have single-port matching color blank inserts available in packs of 10.
 - h. Color shall match nearby electrical devices exactly.
 - i. Furniture faceplates shall fit existing knockouts for telecom receptacles, and snap in without screw mounts.

D. SURFACE-MOUNT BOX (SMB)

- 1. Surface-Mount Box (SMBs) are used to protect terminated Category 6 cables at the endpoints where they are not contained within walls or furniture. Example locations may be Wireless Access Points (WAPs), Group Work Areas fed by conduits run down columns, security cameras, or other network-enabled device locations.

2. Unless otherwise noted all wireless access point (WAP) shall consist of two category 6 jacks (2) and a single 2-port plastic SMB.
3. Small Surface-Mount Boxes shall exhibit the following characteristics:
 - a. Outlet housings for WAPs and other devices shall be a high-density, low profile design with (2) field-configurable ports, snap-lock cover, and cable knockouts on back.
 - b. Housing cover shall have raceway knockouts for top and bottom entry.
 - c. Base shall include Tie-wrap anchor points at all cable entrances.
 - d. The housing shall be mountable with screws, tape or a single magnet.
 - e. The cover shall provide the option of securing it to the base with a screw that is hidden under the outlet identification window.
 - f. Shall be constructed of high-impact self-extinguishing plastic rated UL 94V-0, and be UL Listed and compliant with FCC Part 68 and TIA-568 specifications.

E. DATA CABLES

1. Category 6 ,100-Ohm, 24 AWG, Category 6 4-pair balanced unshielded twisted pair solid annealed copper conductors
2. Cable shall be characterized to 500 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as ETL Verified to TIA-568 Category 6 and ISO/IEC 11801 Class E.
3. Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.
4. Outer Diameter: 0.224" max.
5. Cable shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords
6. All category cabling manufacturers must be able to provide documentation from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.
7. Cable may be CMR rated for areas not running through air handling spaces. CMP cable must be used if cable passes at any point through an air plenum or supply/return air handling space.

2.5 FRAMES, RACKS AND CABINETS

A. FLOOR-MOUNTED 2-POST RACKS

1. Universal junction hole pattern matches most manufacturers racks. #12-24 panel mounting holes. UL Listed (File No. E140851) as a communications circuit accessory.
2. Load Rating: 1000 Lbs. (453.6kg) weight capacity when evenly distributed for the height of the rack (84" (2133mm) and shorter).
3. Add (1) front/rear vertical wire manager on each side or between racks. See Wire Management, below.

4. Permanently stamped rack mount unit (RMU) markings included. Double sided universal (5/8" (16mm), 5/8" (16mm), 1/2" (13mm)) mounting spacing.
5. Includes fifty (50) pilot point #12/24 mounting screws.
6. Approved Manufactures

- a. Chatsworth (CPI)

B. VERTICAL WIRE MANAGERS

1. Provide full height, front-and-rear, 6"-8" wide Vertical Wire Managers at the side of and between each 2-post and/or 4-post termination rack or frame. If space will not allow, the 5" wide wire manager may be substituted at row ends only, leaving the 8" vertical wire manager between each rack. Owner approval in writing is required prior to this substitution.
 - a. Mounting hardware shall be included to insure the proper installation to infrastructure. It shall mount onto a standard TIA/EIA recognized equipment rack.
 - b. The management system shall offer an assortment of accessories, including a bend radius slack loop organizer, cable retainers, and shall accommodate top, bottom, side and pass-through cable routing. Dual hinged, cable concealing covers shall be included.
2. Approved Products:
 - a. Chatsworth (CPI)

C. HORIZONTAL WIRE MANAGERS

1. Provide 2RU Metal 5 ring horizontal wire managers with doors above and below or between every 2RU of patch panel, as space allows.
 - a. Do not coil or wind patch cords inside wire managers.
 - b. Use recessed flat wire manager as needed within enclosed cabinets to route patch cords to opposite sides, where the rings of the flat wire managers would interfere with cabinet door closure.

2.6 CABLE SUPPORTS

A. J-HOOKS

1. All cable shall be supported above ceiling on dedicated cable support hardware.
2. Cable saddles and J-hooks shall be used where cable tray or wire basket is not available. These must be supported on their own ceiling wires, threaded rod, or affixed to building structure by use of beam clamps (on metal beams) or wood screws (on wood beams). Affixing communication cable supports to ceiling support wires and conduit is not allowed.

B. CABLE TRAY

1. In Telecom Room, cable tray (ladder runway) shall be installed to support all cable running to racks and cabinets.
2. Cable tray shall be aluminum, with 12" rung spacing.

3. Cable shall be combed and bundled in all exposed runs outside walls, in TR/TE, and inside cabinets and wire managers.
4. All appropriate cable tray support hardware including angle brackets, rack-to-runway brackets, wall-to-runway brackets, elevation kits, junction splices, butt splices, and grounding jumpers shall be used for a complete and professional installation.

C. JACK/OUTLET BRACKETS

1. Above-ceiling cable termination locations shall be either wall-mounted or suspended from structure above the drop ceiling. Cables or terminations shall not rest on ceiling grid or equipment above ceiling grid.
2. For Wireless Access Points and other above-ceiling-mounted communications devices, cables shall land in an above-ceiling bracket which is affixed to dedicated cable support hardware.
3. Two category-rated jacks may be installed in each above-ceiling bracket. Each above-ceiling bracket will hold a 2-port Surface-Mount Box or 1-U MOS SMB for multimedia applications.
4. For wall-mounted device locations (above or below ceiling), devices needing to be mounted directly to a backbox will utilize the in-wall mounting bracket to secure the jack inside the backbox.
5. One category-rated jack can be installed in each in-wall backbox jack mounting bracket. For devices requiring (2) category-rated jacks, (2) in-wall brackets must be used.

2.7 FIRESTOPPING (Performed by Division 26)

- A. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall:
 1. Meet the hourly rating of the floor or wall penetrated.
 2. Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
 3. Permit multiple devices to be ganged together to increase overall cable capacity.
 4. Allow for retrofit to install around existing cables.
 5. Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes
 6. Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:
 - a. Opening or closing of doors.
 - b. Twisting an inner liner.
 - c. Removal or replacement of any material such as sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
 7. Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

- B. Where non-mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.
 - 1. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
 - 2. Utilize an EMT sleeve as a stub through all walls
 - 3. Surround annular space between EMT sleeve and wall material with a hardening intumescent caulk.
 - 4. Utilize re-enterable, non-hardening putty around cables inside a metal sleeve. Do not exceed 40% fill capacity of sleeve and follow all rated assembly requirements per Manufacturer, local codes, and AHJ.
 - 5. All sleeves to be install by Dev. 26.
- C. Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

2.8 LABELING:

- A. Cables
 - 1. Horizontal cables shall be labeled at each end according to Owner labeling standards (see below). The cable or its label shall be marked with its identifier.
 - 2. Cable labels shall be machine-generated wrap-around labels with multiple cable ID's printed such that it can be viewable in place without turning the cable.
 - 3. Label cables within 6" of termination point at both ends.
- B. Faceplates
 - 1. A unique location identifier shall be marked on each faceplate to identify its location in the cable plant.
 - 2. Each port in the faceplate shall be labeled with its own unique identifier.
- C. Racks, Panels, Blocks
 - 1. A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware.
 - 2. Each port on the connecting hardware shall be labeled with its own identifier to match the other end of the cable.
- D. Ceiling Grid
 - 1. All grid locations that are slated to be used for wireless access point drops above ceiling grid need to be labeled with black on blue TZ type label tape to identify location of drop.

2.9 APPROVED PRODUCT LIST

- A. Leviton / Berk-Tek approved base product list

1. Berk-Tek and Leviton approved material
 - a. 4-Pair Category 6 unshielded twisted pair cabling
 - 1) Plenum
 - a) Blue: 10136226
 - 2) Plenum
 - a) Blue: 10136339
 - b. Head End Termination
 - 1) QuickPort Patch panel: 49255-H48
 - a) Standard User Locations: Black
 - i. Black: 61110-RE6
 - b) Wireless Access Points:
 - i. Green: 61110-RV6
 - c) Audio Visual and Projectors:
 - i. Blue: 61110-RL6
 - d) Intercom Clocks:
 - i. White: 61110-RW6
 - e) Cameras:
 - i. Yellow: 61110-RY6
 - f) HVAC
 - i. Orange: 61110-RO6
 - c. User End Terminations
 - 1) Ivory 4-Port QuickPort faceplate with identification windows: 42080-4IS
 - a) Standard User Locations: Black
 - i. Black: 61110-RE6
 - b) Wireless Access Points:
 - i. Green: 61110-RV6
 - c) Audio Visual and Projectors:
 - i. Blue: 61110-RL6
 - d) Intercom Clocks:
 - i. White: 61110-RW6
 - e) Cameras:
 - i. Yellow: 61110-RY6
 - f) Heat Ventilation and Air Conditioning:
 - i. Orange: 61110-RO6

PART 3 - EXECUTION

3.1 ADDITIONAL INFORMATION

- A. Refer to Section 27 00 00 for the following Part 3 - Execution information
 1. General

2. Cable Pathways
3. Work Area Outlets
4. Installation Practices
5. Labeling
6. Firestopping
7. Sealing of Penetrations and Openings
8. Cable Supports
9. Cable Protection
10. Grounding
11. Documentation
12. Training
13. Cleaning
14. Project Closeout

3.2 CABLE HANDLING / CABLE MANAGEMENT

- A. Proper cable handling is critical to maintaining the design integrity of high-performance cabling. Cable handling recommendations include:
 1. Cable must be conditioned above 32 degrees F for 48 hours prior to installation.
 2. Do not use excessive force when pulling cable. The maximum pull-force guideline for a 4-pair horizontal UTP should not exceed 110N (25lbf). Meeting this guideline avoids stretching conductors during installation and the associated transmission degradation.
 3. The minimum bend radius for UTP should not exceed 4 times the cable outside diameter (O.D.)
 4. Traditional bundling of Category 6 cabling for a combed appearance is required in all exposed locations.
 5. In telecom room, use appropriate horizontal cable management for patch cords on front of patch panels. Also, use appropriate cable management bar(s) for support of terminated horizontal cable.
 6. Do not use vinyl or plastic cable ties due to the potential for over-cinching of cable bundles which can alter the cable geometry and degrade the system cabling performance. Use only hook and loop ("Velcro") fasteners for bundling of horizontal cables.
 7. Store cable slack in an extended loop configuration to alleviate cable stress. Excessive cable slack in bundled loops or traditional 'service loops' to provide additional cable length in TR has been shown to degrade cabling performance and are not recommended.

3.3 SEPARATION OF DATA AND POWER CABLING

- A. Design cable pathways to avoid potential sources of EMI. Avoid installing cable near sources of EMI (X-ray equipment, large motors/generators, electrical power cabling and transformers, Radio frequency (RF) sources and transmitters, lighting, copiers, etc.).

- B. Physically separate power & data cabling according to relevant code and standard requirements when run in a common pathway.
 - 1. Never run data and Class 1 power cabling in parallel closer than 2".
 - 2. Avoid crossing cables if possible. If necessary, always cross cables at 90 degrees.
 - 3. Maintain a minimum of 5 in. separation between data cable and all ballast controlled lighting.
- C. Minimum separation distances of telecommunications cabling from potential sources of EMI exceeding 5kVA:
 - 1. 24" away from Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways
 - 2. 12" away from Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway
 - 3. 6" away from Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway
 - 4. 47" away from Electrical motors and transformers

3.4 INSTALLATION OF STRUCTURED CABLING SYSTEM

A. PRE-INSTALLATION CONFERENCE

- 1. Schedule a conference a minimum of five calendar days prior to beginning work of this section.
- 2. Agenda: Clarify questions related to work to be performed, scheduling, coordination, etc.
- 3. Attendance: Communications system installer, General Contractor, Owner's Representatives and any additional parties affected by work of this section. Owner's Information Technology must be represented at a preconference meeting prior to scheduling of any work.
- 4. Copy of Leviton warranty application will be provided by Contractor.
- 5. Pre-Installation conference may be waived only by Owner.

B. WARRANTY

- 1. A lifetime performance warranty covering all components, equipment and workmanship shall be submitted in writing with system documentation. The warranty period shall begin on the system's first use by Owner.
- 2. The project must be pre-registered with Leviton by the installation contractor before installation has begun, and shall be concluded by contractor with uploading of test results to Leviton and a full project closeout. Warranty paperwork will be delivered directly from Leviton to Owner.
- 3. Should the cabling system fail to perform within its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to Owner.

C. DRAWINGS AND SPECIFICATIONS

1. The Contract drawings and specifications form an integral part of the contract documents. Neither the drawings nor the specifications shall be used alone. Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. Work omitted from the drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirements on drawings, or specifications shall not relieve the Contractor of his or her responsibility of properly completing the Contract.
2. Owner's Project Manager has the option of changing the location of Electrical and Communication outlets to within 3 meters of designed location prior to rough-in stage at no extra cost to Owner. Owner and Owner's Representative requests a chalk/rough-in walk prior to installation to verify locations.
3. The Contractor is responsible to take field measurements where equipment and material dimensions are dependent upon building dimensions and to coordinate and provide a chalk/rough-in walk prior to installation to verify locations.
4. The Contractor shall coordinate with General, Mechanical and Electrical trades as well as Furniture Layout Designer for final workstation outlet locations.
5. Where conflict exists between drawings and specifications the Contractor shall, make allowance for provision of the component, system, or installation process in a manner which will provide the highest monetary cost components, systems, or installation process. Contractor shall inform Owner's Project Managers of the conflict and obtain approvals prior taking corrective measures.

D. REQUIREMENTS AND STANDARDS.

1. Unless otherwise noted a minimum of 1 Category 6 UTP cable and jack shall be installed in all work area outlet (with the exception of wireless access points) locations on a 4-outlet flush mounted faceplate, including offices, utility services, and other common telecommunications locations. The two center positions are to remain blank for future use.
2. Two (2) category 6 UTP cables and jacks shall be installed at all Wireless Access Point locations.
3. All termination wiring shall be T568B termination pattern.
4. A minimum of 2 each 4" inch sleeves must be installed in telecom room for the first one hundred cables. 2 each additional 4" sleeve must be install if the cabling count exceed 100 cables and 2 additions per hundred from there (example: 120 cables will require 4 each 4" conduits while 220 cables will require 6 each 4" conduits).
5. Sleeves for penetration of walls and floors shall have a one hundred percent (100%) spare capacity and shall be fire-stopped as per code.
6. All sleeves shall be installed by Division 26.

E. PATHWAYS AND TOPOLOGY

1. Utilize "thin film" lubricants only! It has been shown that cable-pilling lubricants will affect testing as the cable needs several weeks to dry before attenuation levels recover. Use of incorrect cable lubricants will erode cable jacket and void cable warranty.
2. All cable and wire shall be concealed in conduits, floor ducts, paneling, ceiling or similar areas except at mutually agreed upon areas.

3. Fill capacity in conduit, modular furniture and other horizontal pathways should not exceed 40%. A maximum of 60 % pathway fill is allowed to accommodate unplanned additions after initial installation. To calculate the fill ratio, divide the sum of the cross-sectional area of all cables, by the most restricted cross-sectional area of the pathway.
4. Flat-rung and/or solid bottom cable tray shall be utilized for large, high-density installations. J-hooks and other specific cable support hardware shall be used at all locations outside of cable tray.
5. Pathway design should not exceed (2) 90-degree bends between pull points or pull boxes (PB). If more than (2) 90-degree bends are required, install a pull box between bends.
6. Provide NEC-sized pull boxes for any run greater than 100 feet, or with more than two ninety-degree bends.
7. J-hooks should be randomly spaced 60" or less. Do not exceed J-hook capacity for size and weight limitations.
8. Land wireless access cabling above ceiling, secured onto in-ceiling bracket. A slack loop in the horizontal cabling is not required. Utilize varying-length patch cords when installing wireless access point devices for flexibility in length.
9. Crimp-on modular plugs at wireless access points are not allowed. Terminate all category 6 cabling onto the approved jacks.
10. Mixing of various Category cables in the same pathway is allowed if the applications are appropriate for each category of cable used.
11. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.
12. Maintain a distance of at least 12 inches from all power conduits and cables. Do not install power feeders 100 amps or greater above or within 5 feet of telecommunications backboard. Do not install telecommunications conduits above power panels or switchboards.
13. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
14. Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in telecom room, such that no drilling of additional sleeves/slots is necessary. Sleeves may need to be provided and installed under the scope of this Project.
15. For voice or data applications, 4 pair UTP cables shall be run using a star topology from the telecommunications room to every individual information outlet.
16. Horizontal pathways shall be installed or selected such that the minimum bend radius is maintained both during and after installation.
17. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
18. Install $\frac{3}{4}$ " x 4' x 8' fire-rated plywood across all walls in telecom rooms, from 6" AFF to 8'-6" AFF. Coat with 2 coats of white paint. Do not paint over fire rating stamp.
19. Contractor (shall firestop all used pathways which enter or leave the telecom room via conduit, cable tray or slot. Contractor is responsible for installing sleeves at each wall or partition penetration, and firestopping all fire-rated penetrations. Intumescent caulk shall

be applied around the outside of each sleeve, and intumescent putty inside the sleeve or conduits around the cables. Appropriate fill ratios must be followed when penetrating fire-rated walls.

F. GROUNDING:

1. Refer to Section 270526 for specifications on Grounding and Bonding.
2. All grounding (earthing) and bonding shall be done to applicable codes, standards and regulations.
3. Shielded cabling channels shall include appropriate method of bonding shield to approved ground for proper EMI/RFI mitigation.
4. Shield Continuity Testing shall be enabled when shielded cabling channels are installed.
5. All shielded and armored cables shall be bonded to a telecom grounding system via shielded patch panels at the rack locations. Shielded Category-rated connectors must be properly installed to maintain electrical ground conductivity along entire length of cable and at both ends of the cable. UTP connectors shall not be used on shielded cables at either end.
6. Shielded Patch cords shall be provided for use and employed at each workstation location utilizing shielded cable. Shielded patch cords can be identified by their gray color and metallic RJ45 plug. Shielded patch cords are not required at the patch panels.
7. Telecom Contractor shall bond and ground all telecom room metals. Telecom Contractor shall provide and install TIA-rated Telecommunications Grounding Busbar (TGB) at telecom rack location. All ground lugs shall be 2-hole make-up.
8. Division 26 will provide the all bus bars and the connection between the TGB and building ground.
9. Telecom installer will ground and bond all armored and/or shielded cables, racks, cabinets, cable tray, ladder racking, and shielded panels to telecom grounding busbar within the telecom room.

G. CABLES AND TERMINATIONS:

1. Check plans for final determination of faceplate colors or consult with the Electrical Engineer prior to install.
2. Install additional cables at drop locations and in quantities indicated on the drawings. Do not exceed manufacturers' recommendations for maximum allowable pulling tension, side wall pressure or minimum bending radius. Use pulling compound as recommended by cabling manufacturer.
3. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.
4. The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10m (33 ft).
5. The Contractor shall observe the bending radius and pulling strength requirements of the 4 pair UTP cable during handling and installation.
6. No run of UTP cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall contain splices.
7. In a false ceiling environment, a minimum of 3 inches (75 mm) shall be observed between the cable supports and the false ceiling. Minimum 6" is preferred.

8. J-hooks shall be provided for all suspended cable, at a semi-irregular spacing not to exceed 5 feet between supports. Cables shall be supported by dedicated low-voltage cable support hardware. Support of cables or hanging hardware by means of supports or surfaces related to other trades or applications is not allowed.
9. Provide a full-size service loop (at least once around the inside edge of the box) in each J-box in the communications system.
10. Install all cable in plenum spaces with J-hooks of at least 1" in width to disperse the weight on the bottom cables.
11. Comply with ANSI/TIA-569 for conduit and splice box sizing.
12. Install modular jacks at all outlets shown; one data jack for each data cable at each faceplate or termination point. Install additional cables and modular jacks as indicated on the drawings. Do not "split pairs" between different jacks.
13. Terminate cables at each jack location and at termination board or patch panel. Follow industry guidelines and manufacturers' recommendations and procedures as required. All termination hardware shall be rated to exceed their associated Category rating as specified above.
14. For enclosed ceiling WAP locations, install and terminate two category 6 (2) cables to approximate location as shown on plans. For open-ceiling environments, secure cables and surface-mount boxes to nearest appropriate support structure.
15. For in-ceiling WAP locations, secure jacks inside a surface-mount block mounted to in-ceiling metal assembly, and provide a 5' patch cord or longer, as needed, to connect device to its final determined location in ceiling.
16. Label and identify each outlet and cable for data circuits. Label at outlet end and at termination board or patch panel with matching designations.
17. Extreme care must be taken not to nick any of the copper conductors when removing jacket. Use rip cord to expose pairs for termination onto Insulation Displacement Contacts. Precision strippers with adjustable blade depths may also be used.
18. Maintain twists as close as possible to the point of termination. Untwisting of copper pairs should not exceed 1/4" to the termination point.
19. Manage the cable bundles in a symmetrical orientation. For example, in a 48-port patch panel, distribute 24 cables through the vertical cable management on the left rear side of the rack and 24 cables through the vertical cable management on the right rear side of the rack.
20. Do not dress cables in bundles larger than 24 cables. Multiple 24-cable bundles may be run in parallel with evenly-spaced Velcro cable ties in an orderly sequence.
21. For cable management on rear of patch panel, cable shall sweep into termination points and be supported by appropriate rear cable management.
22. Horizontal patch cord management is required on all installations.
23. Maintain cable bend radius 4X outer diameter (UTP only) when mounting faceplate onto EMT backbox, box-eliminators or furniture knock-outs.
24. Faceplates and SMBs shall be fully installed and labeled prior to testing.

H. ABOVE-CEILING AND WALL-MOUNTED WIRELESS ACCESS POINTS AND DEVICES

1. All WAP locations shall receive (2) Category 6 cables from telecom rack. Multimedia, security and other video devices shall receive (1) Category 6 cables as shown on drawings, documents and details.
2. WAP and other communications cables shall terminate on patch panels in the telecom room. WAP cables shall terminate on Category 6 information outlets and shall be terminated above *the* ceiling in a 2-port SMB.
3. SMB, jacks, and patch cords used in plenum spaces shall be plenum-rated.

I. TERMINAL BLOCKS AND PATCH PANELS:

1. Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.
2. Dress and comb all incoming cable bundles in groups of 24 cables each. Eliminate crossed cables and “divers”.
3. Ground all shielded patch panels to telecom ground source via paint-piercing washers to a grounded rack, or via direct ground wire to telecom bus bar.

J. TELECOM ROOM

1. The rooms shall be able to contain data or telecommunications’ equipment, cable terminations and associated cross-connection wiring. Closet spaces are not to be shared with electrical installations, other than those directly for telecommunications, video, security and information systems equipment. The rooms are not to be shared with other unrelated building service, for example plumbing. Any conflicts with these specifications require the approval of Owner’s project manager.
2. Contractor shall submit a drawing of the telecom room showing layout of all components including necessary and required electrical outlets, conduits, environmental requirements and wire termination fields prior to start of the job. Any jack densities noted in these specifications are estimates only. The drawing will designate the most effective, scalable, jack termination cabling design to facilitate data/telecom outlets shown on the lease exhibits. Owner’s Project Managers must approve drawings prior to installation.
3. All racks, panels, and equipment finished shall be anchored to meet local seismic zone requirements and industry standards. The equipment racks are to be anchored to the concrete floors via “Unistrut or equal metal framing strut systems”, threaded rod, concrete anchors, bolts and washers.
4. The overhead cable ladder system will provide a route for the Category 6, and other communication cables while providing stability to the equipment racks.
5. The vendor is responsible to provide and install the specified count of 19” EIA rack-mount 7’ (45U) 2- post racks. The vendor is responsible for submitting layout drawings to Owner for approval prior to installation.
6. The contractor shall provide high capacity horizontal and vertical cable manager channels are required in all data and equipment racks, and the racks will contain sufficient vertical and horizontal cable managers to facilitate the patch panel density and placement installed by the contractor.
7. Contractor will install raceways, boxes, managers, and enclosures as indicated according to manufacturer’s written instructions. Securely fasten each component to the surface to which it is mounted and remove burs and sharp edges from all cable tray.

8. A ladder rack system is required and will be provided by the contractor and installed in the telecom room to provide cable support to the rack system. This includes all the required ladder rack support items such as rack to runway kits, wall angle brackets, ceiling supports, splices (junction and butt), radius drops and j-bolts. The final ladder rack layout will be included in the telecom room layout drawing described above.
9. Provide and install as needed, 4' x 8" x 3/4" fire-rated plywood board and labeled with fire rating stamp facing into the room to accommodate rack ladder support, cabling support, grounding platform, data and voice equipment. Paint backboard white (leave stamp visible) to match existing backboard in room, if appropriate. Location of installation is to be determined with approval by Owner.

K. PATCH CORDS:

1. Owner Furnished Owner Installed (OFOI).
 - a. Install Category 6 patch cords at the equipment cabinet between Category 6 patch panel and Owner switches. Dress and bundle patch cords as appropriate for final installation.
2. Contractor Furnished Contracted Installed
 - a. If the wireless access points are part of the proposal, then the contractor will be required to install Category 6 patch cords between the work area outlet and the wireless access points. Neatly route, dress and bundle patch cords to assure they are esthetically please for Owner if patching is done by the contractor.
3. LABELING
 - a. Provide machine-generated labels appropriate for all components supplied and installed. Under no circumstances shall hand written labels be used.
 - b. Each faceplate, cable, or data outlet (drop) will be numbered with a unique identifier clearly indicating the voice and data jacks by Closet ID, Rack ID, Panel ID, and Port ID.
 - 1) Ex: 128.1.A-24 (IDF 128 / Rack 1 / Panel A / Port 24)
 - 2) Label at the panel to match
4. The labeling scheme shall not include duplicates of any new or existing cable identification across the entire cable plant.
5. Labeling procedure will meet TIA-568, TIA-606 (Class 2 Administration) and BICSI Standards.
6. The labeling scheme will be provided at all locations within the cable infrastructure:

3.5 TESTING

A. COPPER TESTING

1. Test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of attenuation and NEXT across all splices and devices installed in the field and shall meet latest requirements of EIA/TIA. Re-terminate any cable or connection found to be defective.
2. Tester is to be a Level IV device or better, and configured with the specific cable installed, and the Permanent Link test will be performed according to the Category's standard methodology. All parameters must exhibit a PASS test result prior to project completion. PASS*, FAIL* or FAIL test results will not be accepted.

3.6 TEST RESULTS

1. Repair and resolve any shortcomings in the test results. Mitigation efforts may require re-termination or replacement of the jack, outlet or cable. Repairs or attempts to resolve test failures will be completed solely at the expense of the Contractor.
2. Provide test results to Manufacturer and Owner representative in native Tester format. Upon request, provide a copy of the tester software and license, if needed, at no charge to Owner representative.
3. Include PDF of full test results, summary index in electronic format on CD or memory stick in the O&M package upon project completion.
4. Cabling systems shall meet or exceed the electrical and transmission characteristics of the systems specified.
5. Cable segments and links shall be tested from both ends of the cable for each of the construction phases. (Verify that cable labeling matches at both ends).
6. The system shall not be considered certified until the tester has acknowledged that the performance of the physical layer of the system has been fully tested and is operational at the completion of the installation phase.
7. After the installation is complete, in addition to any other required testing as described herein, and at such times as Owner/Engineer directs, the Contractor shall be present while Owner conducts an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be corrected promptly at the Contractor's expense and the tests performed again.
8. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The tester shall be capable of storing test data in either internal or external memory. The external media used shall be left to the discretion of the user.
9. Test results saved by the tester shall be transferred into a Windows based database utility that allows for maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered as well as any printed reports generated from the software application.
10. Test results shall be provided in both native Tester format as well as comma separated variable (.csv), Portable Document File (.pdf), plain text (.txt), or hypertext markup language (.html/.htm). A copy of the tester native test software must be provided to Owner or Owner's representative for comparison of results.
11. Test Results for CATEGORY 6 shall include the following:
 - a. Applicable room number of jack location (room number per Contract Documents)
 - b. Applicable Telecommunications Room number
 - c. Circuit I.D. number with corresponding jack identifier
 - d. Wire Map – shall include the following:
 - 1) Continuity to the remote end
 - 2) Shorts between any two or more conductors
 - 3) Crossed pairs
 - 4) Reversed pairs
 - 5) Split pairs

- 6) Any other mis-wiring
- e. Length
- f. Insertion Loss
- g. Near-end Crosstalk (NEXT) Loss
- h. PS-NEXT (Power Sum Near End Cross Talk)
- i. FEXT (Far End Crosstalk)
- j. ELFEXT (Equal Level Far End Cross Talk)
- k. PS-ELFEXT (Power Sum Equal Level Far End Cross Talk)
- l. Propagation Delay
- m. Delay Skew
- n. Return loss
- o. PSFEXT (Power Sum Far End Crosstalk)
- p. PSACRF (Power Sum Attenuation to Crosstalk Ratio, Far End)

12. Completion of all wiring, projects, moves adds or changes will be considered complete when contract contacts PSD representative that work has been completed.

3.7 PROJECT CLOSEOUT

- A. Operating and maintenance manuals shall be submitted prior to testing of the system. A total of (4) manuals shall be delivered to Owner. Manuals shall include all service, installation, and programming information.
- B. Provide a full set of "as-built" (redline) drawings in PDF format. Drawings to depict final location and drop/cable identification numbers and labels which match the test reports. Include (1) hard copy paper format of all as-built drawings in 30"x42" size or equivalent, posted in each telecom room involved in the project.

3.8 TRAINING

- A. Offer four (4) hours training on the operation and installation of the data system, at job site, at no cost to Owner.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balanced twisted-pair cabling.
2. RS-232 cabling.
3. RS-485 cabling.
4. Control-voltage cabling.
5. Control-circuit conductors.
6. Fire alarm wire and cable.
7. Identification products.

1.2 DEFINITIONS

- A. 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Cabling administration drawings and printouts.
2. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CATEGORY 5e BALANCED TWISTED-PAIR CABLE

- A. Description: Four-pair, balanced twisted-pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.
- B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables and NFPA 70 for the following types:
 - 1. Communications, Non-plenum: Type CMR complying with UL 1666.
- C. Conductors: 100-ohm, 24 AWG solid copper.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Jacket: White thermoplastic.

2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced twisted-pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables and NFPA 70 for the following types:
 - 1. Communications, Non-plenum: Type CMR complying with UL 1666.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Cable Rating: Riser.
- F. Jacket: Blue thermoplastic.

2.4 BALANCED TWISTED-PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. General Requirements for Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.

- C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- D. Connecting Blocks:
 - 1. 110-style IDC for Category 5e.
 - 2. 110-style IDC for Category 6.
 - 3. 110-style IDC for Category 6a.
 - 4. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 - 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
 - 3. Number of Jacks per Field: One for each four-pair cable indicated.
- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.
- H. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Standard: Comply with TIA-568-C.2.
 - 3. Marked to indicate transmission performance.
- I. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Designed to snap-in to a patch panel or faceplate.
 - 3. Standard: Comply with TIA-568-C.2.
 - 4. Marked to indicate transmission performance.
- J. Faceplate:

1. Two port, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 RS-485 CABLE

A. PVC-Jacketed, TIA 485-A Cables:

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. NFPA 70 Type: Type CM.
6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. NFPA 70 Type: Type CMP
6. Flame Resistance: NFPA 262, Flame Test.

2.6 CONTROL-VOLTAGE CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

2.7 FIRE ALARM WIRE AND CABLE

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, No. 18 AWG or size as recommended by system manufacturer.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
 - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated.

2.8 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test balanced twisted-pair and optical-fiber cables on reels according to TIA-568-C.1.
- C. Factory test balanced twisted-pair cables according to TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 270528.29 "Hangers and Supports for Communications Systems" for installation of supports for cables.

3.2 WIRING METHOD

- A. Install wiring in metal pathways and wireways.
 - 1. Minimum conduit size shall be 3/4 inch. Control and data-transmission wiring shall not share conduits with other building wiring systems.
 - 2. Comply with requirements in Section 270528 "Pathways for Communication Systems."

- B. Install cable, concealed in accessible ceilings, walls, and floors when possible.
- C. Wiring on Racks and within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM's "Cabling Termination Practices" chapter. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.
 - 2. Install lacing bars and distribution spools.
 - 3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
 - 4. Install conductors parallel with or at right angles to sides and back of enclosure.
 - 5. Connect conductors associated with intrusion system that are terminated, spliced, or interrupted in any enclosure onto terminal blocks.
 - 6. Mark each terminal according to system's wiring diagrams.
 - 7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1 and NFPA 70.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
- D. Install balanced twisted-pair cables and connecting materials after spaces are complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- E. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.1.
 - 2. Comply with BICSI "Information Technology Systems Installation Methods Manual."
 - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels. Leave a minimum of 6 inches of slack at outlet terminations and coil loosely into box after termination on outlet fitting.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Maintain minimum cable bending radius during installation and termination of cables.
 - 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

8. Pulling Cable: Monitor cable pull tensions. Do not exceed manufacturer's rated cable-pulling tension.
 9. Riser Cable: Riser cable support intervals shall be in accordance with manufacturer's recommendations.
- F. Balanced Twisted-Pair Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.
1. Comply with TIA-568-C.2.
 2. Install 110-style IDC termination hardware unless otherwise indicated.
 3. Do not untwist balanced twisted-pair cables more than 1/2 inch from point of termination to maintain cable geometry.
- G. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart. Cable supports shall be fastened to structural members or floor slabs in accordance with Section 260528 "Pathways for Communications Systems".
 3. Cable shall not be run in contact with pipes, ducts, or other potentially damaging items. Cables shall not be run through structural members or use structural members, pipes, ducts, or equipment as a support.
- H. Separation from EMI Sources:
1. Comply with BICSI Telecommunications Distribution Methods Manual and TIA-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 communication cables or cables in nonmetallic pathways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches
 - 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 communication cables in grounded metallic pathways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - 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 cables in grounded metallic pathways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - 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.

3.4 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 270528 "Pathways for Communications Systems."
 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
 1. Cables and pathways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 2. Fire-Rated Cables: Use of two-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
 3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or pathway 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 junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. 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.
- G. 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 one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, "Firestopping" Annex.
- C. Comply with BICSI Telecommunications Distribution Methods Manual Telecommunications Distribution Methods Manual, "Firestopping Systems" Article.

3.7 GROUNDING

- A. For communication wiring, comply with TIA-607-B and with BICSI Telecommunications Distribution Methods Manual's "Bonding and Grounding (Earthing)" chapter.

3.8 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Visually inspect balanced twisted-pair and optical-fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Test balanced twisted-pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
 - a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI Telecommunications Distribution Methods Manual as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Remote annunciator.
 - 7. Addressable interface device.

1.2 ACTION SUBMITTALS

- A. General Submittal Requirements.
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect
 - 2. Shop Drawings shall be prepared by persons with the following qualifications.
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level III minimum.
 - c. Licensed or certified by authorities having jurisdiction.
- B. Product Data: For each type of product, including furnished options and accessories.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, details, and attachments to other work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Detail assembly and support requirements.
 - 5. Include voltage drop calculations for notification-appliance circuits.
 - 6. Include battery-size calculations.
 - 7. Include input/output matrix.
 - 8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
 - 9. Include performance parameters and installation details for each detector.

10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring required for HVAC unit shutdown on alarm.
 - c. Locate detectors according to manufacturer's written recommendations.
- D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment.
 - d. Riser diagram.
 - e. Record copy of site-specific software.
 - f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.

- 2) Frequency of testing of installed components.
- 3) Frequency of inspection of installed components.
- 4) Requirements and recommendations related to results of maintenance.
- 5) Manufacturer's user training manuals.
- g. Manufacturer's required maintenance related to system warranty requirements.
- h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Expand existing fire alarm control system to support new devices required for remodel. Provide all materials, cabling, conduit, devices, and batteries as required for complete operable system.
- B. Source Limitations for Fire-Alarm System and Components: Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- C. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- D. All components provided shall be listed for use with the existing fire alarm system.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEM OPERATION DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
 2. Identify alarm and specific initiating device at fire-alarm control unit.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 6. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 7. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions.
1. Valve supervisory switch.
 2. Loss of communication with any panel on the network.
- D. 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 communication with any addressable sensor, input module, relay, control module, or remote annunciator.
 4. Loss of primary power at fire-alarm control unit.
 5. Ground or a single break in internal circuits of fire-alarm control unit.
 6. Abnormal ac voltage at fire-alarm control unit.
 7. Break in standby battery circuitry.
 8. Failure of battery charging.
 9. Abnormal position of any switch at fire-alarm control unit.
- E. System Supervisory Signal Actions:
1. Initiate notification appliances.
 2. Identify specific device initiating the event at fire-alarm control unit.
 3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

2.3 FIRE-ALARM CONTROL UNIT

- A. Existing Fire-Alarm Control Unit.
1. Existing Notifier Alarm Control Panel Model #NFS-320.

- a. Expand existing fire alarm control system to support new devices required for remodel. Provide all materials, cabling, conduit, devices, and batteries as required for complete operable system.
- B. 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, and component status messages and the programming and control menu.
 1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
 3. Provide remote annunciator at new building entry.
- C. Battery Power: Provide additional battery capacity and cabinets as required to support expansion of existing system.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 1. Comply with UL 268; operating at 24-V dc, nominal.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 4. Integral Visual-Indicating Light: LED type, indicating detector has operated.
- B. Photoelectric Smoke Detectors:
 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

2.6 CARBON MONOXIDE DETECTORS

- A. General: Carbon monoxide detector listed for connection to fire-alarm system.
 - 1. Mounting: Adapter plate for outlet box mounting.
 - 2. Testable by introducing test carbon monoxide into the sensing cell.
 - 3. Detector shall provide alarm contacts and trouble contacts.
 - 4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
 - 5. Comply with UL 2075.
 - 6. Locate, mount, and wire according to manufacturer's written instructions.
 - 7. Provide means for addressable connection to fire-alarm system.
 - 8. Test button simulates an alarm condition.

2.7 INTELLIGENT DUCT SMOKE DETECTORS

- A. In-duct smoke detector Housing: Uses intelligent photoelectric detector which provides continuous analog monitoring and alarm verification.
- B. When sufficient smoke is sensed an alarm signal is initiated and appropriate action taken to shut-down or change over air handling systems to help prevent rapid distribution of smoke and fire gases throughout the areas served by the duct system.
- C. Duct Smoke Detectors Mounted Above Ceiling or Otherwise Obstructed from Normal View:
 - 1. Provide with remote alarm indicator.
- D. Each Detector: Install in either supply side or return side duct in accordance with local mechanical code.
- E. Detector shall provide a Trouble signal for sensor cover removal, and shall be capable of testing via magnetic switch or remote testing with the RTS151KEY remote test station.

2.8 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
 - 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.9 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Horn/Strobes: 25 or 70-V dc; with provision for housing the operating mechanism behind a grille. Horn shall have frequency range of 400 to 4,000 Hz. Comply with UL 1480 and UL 1971.
- C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
 1. Mounting: Wall mounted unless otherwise indicated.
 2. Flashing shall be in a temporal pattern, synchronized with other units.
 3. Strobe Leads: Factory connected to screw terminals.
 4. Mounting Faceplate: Factory finished, red.

2.10 ADDRESSABLE INTERFACE DEVICE

- A. General:
 1. Include address-setting means on the module.
 2. Store an internal identifying code for control panel use to identify the module type.
 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Control Module:
 1. Operate notification devices.
 2. Operate solenoids for use in sprinkler service.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
- C. Manual Fire-Alarm Boxes:
 1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 2. Mount manual fire-alarm box on a background of a contrasting color.

3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
4. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
5. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
6. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
7. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 PATHWAY

- A. Pathways shall be installed in EMT.
- B. Exposed EMT shall be painted red enamel.
- C. Where fire alarm cabling can be concealed above accessible ceilings open cabling may be utilized.

3.3 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches 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 HVAC duct systems.
 2. Electronically locked doors and access gates.
 3. Supervisory connections at valve supervisory switches.
 4. Supervisory connections at elevator shunt-trip breaker.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Install framed instructions in a location visible from fire-alarm control unit.

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.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Perform the following tests and inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. 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" chapter.
 - b. Comply with the "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.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION